APPROVED COURSE STRUCTURE AND SYLLABI

BACHELOR OF ENGINEERING DEGREE EXAMINATIONS

(CE, ME, MetE, MinE, EE, ETcE, CSTE, IT Branches)

AND

BACHELOR OF ARCHITECTURE DEGREE EXAMINATIONS

From July, 2005

Bengal Engineering and Science University, Shibpur

HOWRAH- 711 103

Dean, FEAT
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CONTENT

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PART - I

COURSE STRUCTURE:

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COURSE STRUCTURE FOR THE BACHELOR OF ENGINEERING

	1st. Semester(common to all Engineering Branches)								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Mathematics-I	MA101	3	1	0		100		
2	Chemistry / Physics	CH1201 / PH1201	3	1	0		100		
3	Intro to Computing / Prof.Comm.in English	CS1201/HU1201	2	1	0		50		
4	Environment & Ecology	CE101	2	0	0		50		
5	BasicElectricalEngg./ BasicElectronicsEngg.	EE1201/ET1201	3	1	0		100		
6	Engineering Drawing-I	DR101	1	0	0		100		
7	Chemistry Lab. / Physics Lab.	CH1251/PH1251	0	0	3			50	
8	Computing Practice / Workshop Practice	CS1251 / WS1251	0	0	3			50	
9	BasicElectricalEnggLab / BasicElectronicsEnggLab	EE1251/ET1251	0	0	3			50	
10	Engineering Drawing Practice-I	DR151	0	0	6			100	
		Total:	14	4	15	33	500	250	750
	Additional Elective								
	NCC / Physical Training-I (for all the departments)	SA191	0	0	2			50	
		(Marks obtained more than the Pass Marks will be added to the Total)							
	2nd. Semester(common to all Engineering Branches)								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Mathematics-II	MA201	3	1	0		100		
2	Physics / Chemistry	PH1201 / CH1201	3	1	0		100		
3	Prof.Comm.in English/Intro to Computing	HU1201 / CS1201	2	1	0		50		
4	Engineering Mechanics	AM201	3	1	0		100		
5	BasicElectronicsEngg. / BasicElectricalEngg.	ET1201 / EE1201	3	1	0		100		
6	Engineering Drawing-II	DR201	1	0	0		100		
7	Physics Lab./ Chemistry Lab.	PH1251 / CH1251	0	0	3			50	
8	Workshop Practice / Computing Practice	WS1251 / CS1251	0	0	3			50	
9	Engineering Mechanics Lab.	AM251	0	0	2			50	
10	Basic Electronics Engg Lab / Basic Electrical Engg Lab	ET1251 / EE1251	0	0	3			50	
11	Engineering Drawing Practice-II	DR251	0	0	3			100	
		Total:	15	5	14	34	550	300	850
	Additional Elective								
	NCC / Physical Training-II (for all the departments)	SA291	0	0	2			50	
		(Marks obtained more than the Pass Marks will be added to the Total)							

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	1st. Semester(common to CE, ME, MetE, MinE Branches)								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Mathematics-I	MA101	3	1	0		100		
2	Chemistry	CH1201	3	1	0		100		
3	Intro to Computing	CS1201	2	1	0		50		
4	Environment & Ecology	CE101	2	0	0		50		
5	BasicElectricalEngg	EE1201	3	1	0		100		
6	Engineering Drawing-I	DR101	1	0	0		100		
7	Chemistry Lab.	CH1251	0	0	3			50	
8	Computing Practice	CS1251	0	0	3			50	
9	BasicElectricalEnggLab	EE1251	0	0	3			50	
10	Engineering Drawing Practice-I	DR151	0	0	6			100	
		Total:	14	4	15	33	500	250	750
	Additional Elective								
	NCC / Physical Training-I (for all the departments)	SA191	0	0	2			50	
		(Marks obtained more than the Pass Marks will be added to theTotal)							

	2nd. Semester(common to CE, ME, MetE, MinE Branches)								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Mathematics-II	MA201	3	1	0		100		
2	Physics	PH1201	3	1	0		100		
3	Prof.Comm.in English	HU1201	2	1	0		50		
4	Engineering Mechanics	AM201	3	1	0		100		
5	BasicElectronicsEngg..	ET1201	3	1	0		100		
6	Engineering Drawing-II	DR201	1	0	0		100		
7	Physics Lab	PH1251	0	0	3			50	
8	Workshop Practice	WS1251	0	0	3			50	
9	Engineering Mechanics Lab.	AM251	0	0	2			50	
10	Basic Electronics Engg Lab	ET1251	0	0	3			50	
11	Engineering Drawing Practice-II	DR251	0	0	3			100	
		Total:	15	5	14	34	550	300	850
	Additional Elective								
	NCC / Physical Training-II (for all the departments)	SA291	0	0	2			50	
		(Marks obtained more than the Pass Marks will be added to theTotal)							

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	1st. Semester(common to EE, ETcE, CSTE, IT Branches)								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Mathematics-I	MA101	3	1	0		100		
2	Physics	PH1201	3	1	0		100		
3	Prof.Comm.in English	HU1201	2	1	0		50		
4	Environment & Ecology	CE101	2	0	0		50		
5	BasicElectronicsEngg.	ET1201	3	1	0		100		
6	Engineering Drawing-I	DR101	1	0	0		100		
7	Physics Lab.	PH1251	0	0	3			50	
8	Workshop Practice	WS1251	0	0	3			50	
9	BasicElectronicsEnggLab	ET1251	0	0	3			50	
10	Engineering Drawing Practice-I	DR151	0	0	6			100	
		Total:	14	4	15	33	500	250	750
	Additional Elective								
	NCC / Physical Training-I (for all the departments)	SA191	0	0	2			50	
		(Marks obtained more than the Pass Marks will be added to theTotal)							

	2nd. Semester(common to EE, ETcE, CSTE, IT Branches)								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Mathematics-II	MA201	3	1	0		100		
2	Chemistry	CH1201	3	1	0		100		
3	Intro to Computing	CS1201	2	1	0		50		
4	Engineering Mechanics	AM201	3	1	0		100		
5	BasicElectricalEngg.	EE1201	3	1	0		100		
6	Engineering Drawing-II	DR201	1	0	0		100		
7	Chemistry Lab.	CH1251	0	0	3			50	
8	Computing Practice	CS1251	0	0	3			50	
9	Engineering Mechanics Lab.	AM251	0	0	2			50	
10	Basic Electrical Engg Lab	EE1251	0	0	3			50	
11	Engineering Drawing Practice-II	DR251	0	0	3			100	
		Total:	15	5	14	34	550	300	850
	Additional Elective								
	NCC / Physical Training-II (for all the departments)	SA291	0	0	2			50	
		(Marks obtained more than the Pass Marks will be added to theTotal)							

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	3rd. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Mathematics-IIIA	MA301	3	1	0		100		
2	Engineering Geology	GE301	3	0	0		100		
3	Solid Mechanics-I	AM301	3	1	0		100		
4	Hydraulics-I	AM302	3	1	0		100		
5	Surveying-I	CE301	3	1	0		100		
6	Engg MaterialsConst&Services	CE302	3	0	0		100		
7	Solid Mechanics-I Lab.	AM351	0	0	3			50	
8	Hydraulics-I Lab	AM352	0	0	3			50	
9	Civil Engineering Drawing	CE351	0	0	6			100	
		Total:	18	4	12	34	600	200	800
	4th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Solid Mechanics-II	AM401	3	1	0		100		
2	Hydraulics-II	AM402	3	1	0		100		
3	Structural Analysis-I	CE401	3	2	0		100		
4	Surveying-II	CE402	3	1	0		100		
5	Concrete Technology	CE403	3	1	0		100		
6	Planning Estimating & Valuation	CE404	3	1	0		100		
7	Solid Mechanics -II Lab.	AM451	0	0	3			50	
8	Hydraulics-II Lab	AM452	0	0	3			50	
9	Planning Drawing & Estimation	CE451	0	0	3			50	
10	Surveying Practical #	CE471	0	0	0			50	
		Total:	18	7	9	34	600	200	800
	# 2 weeks at the beginning of the semester								

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	5th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Economics & Accountancy	HU5601	2	0	0		50		
2	Principles of Management	HU5602	2	0	0		50		
3	Design of R.C. Structures	CE501	3	0	0		100		
4	Soil Mechanics-I	CE502	3	1	0		100		
5	Water Resources Engineering	CE503	3	2	0		100		
6	Environmental Engineering-I	CE504	3	2	0		100		
7	Transportation Engineering-I	CE505	3	2	0		100		
8	Concrete Technology Lab	CE551	0	0	3			50	
9	Project-I	CE552	0	0	6			200	
10	Survey Practical-II	CE571	0	0	0			50	
		Total:	19	7	9	35	600	300	900
	6th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Design of Steel Structures	CE601	3	1	0		100		
2	Structure Analysis-II	CE602	3	2	0		100		
3	Soil Mechanics-II	CE603	3	2	0		100		
4	Irrigation and Hydraulic Structure	CE604	3	1	0		100		
5	Environmental Engineering-II	CE605	3	1	0		100		
6	Transportation Engineering-II	CE606	3	1	0		100		
7	Structural Engineering Lab	CE651	0	0	3			50	
8	Project-II	CE652	0	0	6			200	
9	Viva-voce - I	CE671	0	0	0			100	
		Total:	18	8	9	35	600	350	950

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	7th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Structural Analysis-III	CE701	3	0	0		100		
2	Foundation Engineering	CE702	3	1	0		100		
3	Disaster Mitigation	CE703	3	0	0		100		
4	IT & GIS in Civil Engineering	CE704	2	0	0		50		
5	Advance Structural Design	CE705	3	0	0		100		
6	Soil Mechanics Lab	CE751	0	0	3			50	
7	Water Resources Engineering Lab	CE752	0	0	3			50	
8	GIS Sessional	CE753	0	0	2			50	
9	Environmental Engineering Lab	CE754	0	0	3			50	
10	Transportation Engineering Lab	CE755	0	0	3			50	
11	Project III	CE756	0	0	6			150	
11	Seminar	CE771	0	0	0			50	
		Total:	14	1	20	35	450	450	900
	8th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Professional values and ethics	HU7801	2	0	0		50		
2	Construction Technology	CE801	3	1	0		100		
3	Project Planing and Management	CE802	3	1	0		100		
4	Elective-I (Dept.)	CE803/d	3	0	0		100		
5	Elective-II (Dept.)	CE804/d	3	0	0		100		
6	Elective-III (Non-deptt/Deptt)	XX80n/d/CE805/d	2	0	0		50		
7	Elective -I Lab. (Dept.)	CE851/d	0	0	3			50	
8	Elective-II Lab. (Dept.)	CE852/d	0	0	3			50	
9	Project-IV	CE853	0	0	9			250	
10	Comprehensive Viva-Voce-II	CE871	0	0	0			100	
		Total:	16	2	15	33	500	450	950

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Mechanical Engineering

	3rd. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Mathematics-IIIA	MA301	3	1	0		100		
2	Material Science	PH301	3	0	0		50		
3	Dynamics of Rigid Bodies	AM303	3	1	0		100		
4	Mechanics of Solids-I	AM304	3	1	0		100		
5	Mechanics of Fluids-I	AM305	3	1	0		100		
6	Basic Thermodynamics	ME301	3	1	0		100		
7	Machine Shop Practice-I	WS351	0	0	3			50	
8	Computer Graphics Practice	DR351	0	0	3			50	
9	Mechanics of Solids-I Lab.	AM353	0	0	2			50	
10	Mechanics of Fluids-I Lab.	AM354	0	0	2			50	
11	Basic Mechanical Engineering Lab.	ME351	0	0	2			50	
		Total:	18	5	12	35	550	250	800
	4th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Mechanics of Solids-II	AM403	3	1	0		100		
2	Mechanics of Fluids-II	AM404	3	1	0		100		
3	Introduction to Mechanical Design	ME401	3	0	0		50		
4	Applied Thermodynamics	ME402	3	1	0		100		
5	Engineering Materials and Processes	ME403	3	1	0		100		
6	Measurement and Control	ME404	3	1	0		100		
7	Machine Shop Practice II	WS451	0	0	3			50	
8	Machine Drawing	DR451	0	0	3			50	
9	Mechanics of Solids-II Lab.	AM453	0	0	2			50	
10	Mechanics of Fluids-II Lab.	AM454	0	0	2			50	
11	Apllied Thermodynamics Lab.	ME451	0	0	3			50	
		Total:	18	5	13	36	550	250	800

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Mechanical Engineering

	5th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Economics & Accountancy	HU5601	2	0	0		50		
2	Principles of Management	HU5602	2	0	0		50		
3	Design of Machine Elements-I	ME501	3	1	0		100		
4	Internal Combustion Engines	ME502	3	1	0		100		
5	Heat Transfer	ME503	3	1	0		100		
6	Machine Tools & Metal Cutting	ME504	3	0	0		100		
7	Kinematics of Mechanisms	ME505	3	1	0		100		
8	Design o Machine Elements-I Sessional	ME551	0	0	3			100	
9	Internal Combustion Engines Lab.	ME552	0	0	3			50	
10	Heat Transfer Lab.	ME553	0	0	2			50	
11	Machine Tool Lab.	ME554	0	0	2			50	
12	Metrology Practice Lab.	ME555	0	0	3			50	
		Total:	19	4	13	36	600	300	900
	6th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Dynamics of Machjnes & Vibration	AM601	3	0	0		100		
2	Design of Machine Elements-II	ME601	3	1	0		100		
3	Boiler & Steam Turbine	ME602	3	1	0		100		
4	Industrial Engineering & Management	ME603	3	1	0		100		
5	Manufacturing Technology	ME604	3	0	0		100		
6	Numerical Methods in Engineering	ME605	3	1	0		100		
7	Design of Machine Elements-II Sessional	ME651	0	0	3			100	
8	Strem Power Lab.	ME652	0	0	3			50	
9	Manufacturing Technology Lab.	ME653	0	0	3			50	
10	Computer Practice on Numerical Methods	ME654	0	0	3			50	
11	Viva Voce-I	ME671	0	0	0			100	
		Total:	18	4	12	34	600	350	950

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Mechanical Engineering

	7th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Tribo Design of Machine Elemants	ME701	3	1	0		100		
2	Refrigeration and Air-Conditioning	ME702	3	0	0		100		
3	Automation and Computerized Manufacturing	ME703	3	0	0		100		
4	Operations Management	ME704	3	0	0		100		
5	Fluid Power Engineering	AM701	3	0	0		100		
6	Elective I (Dept.)	ME705/d	3	1	0		100		
7	Tribo Design of Machine Elemants Sessional	ME751	0	0	3			50	
8	Fluid Power Engineering Lab	AM751	0	0	3			50	
9	Computerized Manufacturing Lab	ME752	0	0	3			50	
10	Project & Thesis Preliminary	ME753	0	0	3			100	
11	Seminar and Group Discussion	ME754	0	0	3			50	
		Total:	#	2	15	35	600	300	900

	8th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Professional values and ethics	HU7801	2	0	0		50		
2	Design of Machanical Systems	ME801	3	1	0		100		
3	Power Plant Engineering	ME802	3	0	0		100		
4	Non-Traditional Manufacturing & Nano-Technology	ME803	3	0	0		100		
5	Elective II (Dept.)	ME804/d	3	1	0		100		
6	Elective III (Non-deptt/Dept.)	XX80n/d/ME805/d	2	0	0		50		
7	CAD of Mechanical System Lab.	ME851	0	0	3			50	
8	Non-Traditional Machining Lab	ME852	0	0	3			50	
9	Elective II Sessional	ME853	0	0	3			50	
10	Project, Thesis & Viva (150+50)	ME854	0	0	6			200	
11	Grand Viva	ME871	0	0	0			100	
		Total:	#	2	15	33	500	450	950

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Metallurgical Engineering

	3rd. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Mathematics-IIIA	MA301	3	1	0		100		
2	Fluid Mechanics	AM306	3	1	0		100		
3	Instrumentation & Control	EE306	4	0	0		100		
4	Gen. Mechanical Engg.-I	ME302	3	1	0		100		
5	Introduction to Materials	MT301	3	1	0		100		
6	Metallurgical Thermodynamics&Kinetics	MT302	3	1	0		100		
7	Fluid Mechanics Lab.	AM355	0	0	3			50	
8	Instrumentation & Control Lab	EE356	0	0	3			50	
9	Gen. Mechanical Engg.-I Lab.	ME352	0	0	3			50	
10	Introduction to Materials Lab.	MT351	0	0	3			50	
		Total:	19	5	12	36	600	200	800
	4th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Instrumental Chemical Analysis	CH401	2	1	0		50		
2	Strength of Materials	AM405	3	1	0		100		
3	Gen. Mechanical Engg.-II	ME405	3	1	0		100		
4	Introduction to Physical Metallurgy	MT401	3	1	0		100		
5	Deformation Behaviour of Materials	MT402	3	1	0		100		
6	Principles of Extractive Metallurgy	MT403	3	1	0		100		
7	Instrumental Chemical Analysis Lab.	CH451	0	0	4			100	
8	Strength of Materials Lab.	AM455	0	0	3			50	
9	Introduction to Physical Metallurgy Lab.	MT451	0	0	4			100	
		Total:	17	6	11	34	550	250	800

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Metallurgical Engineering

	5th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Economics and Accountancy	HU5601	2	0	0		50		
2	Principles of Management	HU5602	2	0	0		50		
3	Phase Transformation	MT501	3	1	0		100		
4	Iron Making	MT502	3	1	0		100		
5	X-ray & Crystallography	MT503	3	1	0		100		
6	Data Pricessing & Computer Application	MT504	3	1	0		100		
7	Polymer Technology	CH501	2	1	0		50		
8	Phase Transformation Lab.	MT551	0	0	3			100	
9	X-ray & Crystallography Lab.	MT552	0	0	3			100	
10	Data Processing & Computer Application Lab.	MT553	0	0	3			100	
11	Viva Voce I	MT571	0	0	2			50	
	Note:	Total:	18	5	11	34	550	350	900
7	Polymer and Refractories Technology	CH501					50		
	6th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Steel Making and Ferro allos technology	MT601	3	1	0		100		
2	Material Characterisation	MT602	3	1	0		100		
3	Non-ferous Matellurgy	MT603	3	1	0		100		
4	Material Properties Evaluation	MT604	3	1	0		100		
5	Heat Treatment Technology	MT605	3	1	0		100		
6	Metal Casting Technology	MT606	3	1	0		100		
7	Material Properties Evaluation Lab.	MT651	0	0	3			100	
8	Materials Characterization Lab.	MT652	0	0	2			50	
9	Heat Treatment Technology Lab.	MT653	0	0	3			100	
10	Metal Casting Technology Lab.	MT654	0	0	2			50	
11	Viva-voce-II	MT671	0	0	0			50	
12	Industrial Visit #	MT672	0	0	0			OO	
		Total:	18	6	10	34	600	350	950
	# 10 days Indistrial Tour								

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Metallurgical Engineering

	7th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Composites and Ceramic Materials	MT701	3	1	0		100		
2	Materials Processing	MT702	3	1	0		100		
3	Joining of Materials	MT703	3	1	0		100		
4	Degradation Materials and their Prevention	MT704	3	1	0		100		
5	Elective-I (Dept.)	MT705/d	3	1	0		100		
6	Industrial Management	ME706	3	1	0		100		
7	Composites and Ceramic Materials Lab.	MT751	0	0	2			50	
8	Joining of Materials Lab	MT752	0	0	3			100	
9	Degradation Materials Lab.	MT753	0	0	2			50	
10	Project Preliminary	MT754	0	0	2			50	
11	Viva Voce III	MT771	0	0	0			50	
		Total:	18	6	9	33	600	300	900
	8th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Professional values and ethics	HU7801	2	0	0		50		
2	Powder Metallurgy	MT801	3	1	0		100		
2	Degin and Selection of Materials	MT802	3	1	0		100		
3	Elective-II (Dept.)	MT803/d	3	1	0		100		
4	Elective III (Non-dept/Dept.)	XX80n/d/MT804/d	2	0	0		50		
5	Elective-IV (Dept.)	MT805/d	3	1	0		100		
6	Power Metallurgy Lab.	MT851	0	0	3			100	
7	Degin and Selection of Materials Lab.	MT852	0	0	2			50	
8	Seminar and Group Discussion	MT853	0	0	2			50	
9	Projects & Thesis	MT854	0	0	5			150	
10	Viva-voce II	MT871	0	0	0			100	
		Total:	16	4	12	32	500	450	950

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Mining Engineering

	3rd. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Mathematics-IIIA	MA301	3	1	0		100		
2	Fluid Mechanics	AM306	3	1	0		100		
3	Electro Technology in mining	EE307	4	0	0		100		
4	Heat Power	ME303	2	1	0		50		
5	Introduction to Mining	MN301	3	1	0		100		
6	Mine Development	MN302	3	1	0		100		
7	Fluid Mechanics Lab.	AM355	0	0	3			50	
8	Electro Technology Lab.	EE357	0	0	2			50	
9	Heat Power Lab.	ME353	0	0	2			50	
10	Introduction to Mining Lab.	MN351	0	0	2			50	
11	Mine Development Lab.	MN352	0	0	3			50	
		Total:	18	5	12	35	550	250	800
	4th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Introduction to Geology	GE401	3	1	0		100		
2	Strength of Materials	AM405	3	1	0		100		
3	Underground Coal Mining	MN401	3	1	0		100		
4	Surface Mining	MN402	3	1	0		100		
5	Underground Mine Environment	MN403	3	1	0		100		
6	Mines Surveying	MN404	3	1	0		100		
7	Introduction to Geology Lab.	GE451	0	0	2			50	
8	Strength of Materials Lab.	AM455	0	0	3			50	
9	Mines Surveying Practical	NN451	0	0	4			50	
10	Educational Tour	MN471	0	0	0			50	
		Total:	18	6	9	33	600	200	800

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Mining Engineering

	5th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Economics and Accountancy	HU5601	2	0	0		50		
2	Principles of Management	HU5602	2	0	0		50		
3	Mining Geology	GE501	3	1	0		100		
4	Mine Ventilation Engineering	MN501	3	1	0		100		
5	Fundamentals of Rock Mechanics	MN502	3	1	0		100		
6	Advanced Surveying	MN503	3	1	0		100		
7	Under ground Mining Machinery	MN504	3	1	0		100		
8	Mining Geology Lab.	GE551	0	0	2			50	
9	Survey Practical	MN551	0	0	3			50	
10	Under ground Mining Machinery Lab.	MN552	0	0	2			50	
11	Ventilation Engineering Lab.	MN553	0	0	2			50	
12	Rock Mechanics Lab.	MN554	0	0	2			50	
13	V.T.Evaluation-I	MN571	0	0	0			50	
		Total:	19	5	11	35	600	300	900
	6th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Stratigraphy & Paleontology	GE601	3	1	0		100		
2	Rock Mechanics Applications	MN601	3	1	0		100		
3	Optimization techniques in mineral industry	MN602	3	1	0		100		
4	Environmental Science & Engineering	MN603	3	1	0		100		
5	Underground Metal Mining	MN604	3	1	0		100		
6	Opencast Mining Machinery	MN605	3	1	0		100		
7	Stratigraphy & Paleontology Lab.	GE651	0	0	2			50	
8	Opencast Mining Machinery Lab.	MN651	0	0	2			50	
9	Environmental Science & Engineering Lab.	MN652	0	0	2			50	
10	Optimization techniques Lab.	MN653	0	0	3			50	
11	Report on Educational tour-II	MN671	0	0	0			50	
12	Comprehensive Viva-voce & VT evaluation	MN672	0	0	0			100	
		Total:	18	6	9	33	600	350	950

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Mining Engineering

	7th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Mine Act, Regulation & Legislation	MN701	3	1	0		100		
2	Mineral Beneficiation	MN702	3	1	0		100		
3	Principles of Mineral Economics	MN703	3	1	0		100		
4	Computer Applications of Mining	MN704	3	1	0		100		
5	Special Underground Methods	MN705	3	1	0		100		
6	Elective-I (Dept.)	MN706/d	3	1	0		100		
7	Mineral Beneficiation Lab	MN751	0	0	2			50	
8	Computer Applications of Mining Lab	MN752	0	0	3			50	
9	Elective-I Lab	MN753/	0	0	2			50	
10	Project Preliminaries	MN553	0	0	2			50	
11	Seminar and Group Discussion	MN754	0	0	2			50	
12	V.T.Evaluation-II	MN571	0	0	0			50	
		Total:	18	6	11	35	600	300	900
	8th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Professional values and ethics	HU7801	2	0	0		50		
2	Ergonomics and Geo-informatics	MN801	3	1	0		100		
3	Principles of Mine Management	MN802	3	1	0		100		
4	Mine Planning and Design	MN803	3	1	0		100		
5	Elective-II (Dept.)	MN804/d	3	1	0		100		
6	Elective-III (Non-dept./Dept.)	XX80n/d/MN805/d	2	0	0		50		
7	Mine Planning and Design Practical	MN851	0	0	3			50	
8	Elective-II Sessional	MN852	0	0	3			50	
9	Seminar and Group Discussion	MN853	0	0	3			100	
10	Project and Thesis	MN854	0	0	6			150	
11	Comprehensive Viva-voce	MN871	0	0	0			100	
		Total:	16	4	15	35	500	450	950

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Electrical Engineering

	3rd Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Mathematics-IIIB	MA302	4	0	0		100		
2	Strength of Materials & Theory of Machines	AM307	3	1	0		100		
3	Electrical Engineering Materials	PH302	2	0	0		50		
4	Networks and Circuits	EE301	4	0	0		100		
5	Electrical Measurements-I	EE302	4	0	0		100		
6	Electrical Machines-I	EE303	4	0	0		100		
7	Strength of Materials & Theory of Machines Lab.	AM356	0	0	3			50	
8	Network & Measurement-I Lab	EE351	0	0	4			100	
9	Electrical Machines-I Lab	EE352	0	0	4			50	
10	Electrical Installation & Costing Sessional	EE353	0	0	3			50	
		Total:	21	1	14	36	550	250	800
	4th Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Fluid Mechanics & Fluid Machines	AM406	3	1	0		100		
2	Electrical Measurements-II	EE401	4	0	0		100		
3	Electrical Machines-II	EE402	4	0	0		100		
4	Field & Circuit Theory	EE403	4	0	0		100		
5	Solid State Devices and Circuits-I	EE404	4	0	0		100		
6	Numericl Methods & Data Structrures	EE405	3	1	0		100		
7	Fluid Mechanics & Fluid Machines Lab.	AM456	0	0	3			50	
8	Networks & Measurement-II Lab.	EE451	0	0	3			50	
9	Electrical Machines-II Lab.	EE452	0	0	4			50	
10	Data Structure Lab.	EE453	0	0	2			50	
		Total:	22	2	12	36	600	200	800

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Electrical Engineering

	5th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Heat Power	ME506	3	0	0		100		
2	Electrical Machines-III	EE501	4	0	0		100		
3	Electrical Power Systems-I	EE502	4	0	0		100		
4	Solid Sate Devices and Circuits-II	EE503	4	0	0		100		
5	Control System-I	EE504	4	0	0		100		
6	Electrical Machine Design	EE505	2	0	0		50		
7	Heat Power Lab.	ME556	0	0	2			50	
8	Elecal Machines-III Lab	EE551	0	0	4			50	
9	Solid State Circuits and Control System Lab.	EE552	0	0	4			100	
10	Electrical Machine Design Sessional-I	EE553	0	0	2			50	
11	Group Discussion and Semeinar	EE554	0	0	2			50	
12	Viva Voce-I	EE571	0	0	0			50	
		Total:	21	0	14	35	550	350	900
	6th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Economics and Accountancy	HU5601	2	0	0		50		
2	Principles of Management	HU5602	2	0	0		50		
3	Electrical Machines-IV	EE601	4	0	0		100		
4	Electrical Power Systems-II	EE602	4	0	0		100		
5	Control System-II	EE603	4	0	0		100		
6	Instrumentation	EE604	4	0	0		100		
7	Microprocessor and Interfacing	EE605	4	0	0		100		
8	Electrical Machines and Power Systems Lab.	EE651	0	0	4			100	
9	Control System and Microprocessor Lab.	EE652	0	0	4			100	
10	Electrical Machine Dedign Sessional-II	EE653	0	0	3			50	
11	Industrial Visit and/or Survey Camp #	EE671	0	0	0			50	
12	Viva Voce-II	EE672	0	0	0			50	
		Total:	24	0	11	35	600	350	950
	# (15 days)								

Electrical Engineering

	7th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Professional values and ethics	HU7801	2	0	0		50		
2	Electrical Power Systems-III	EE701	4	0	0		100		
3	Industrial Power Electronics	EE702	4	0	0		100		
4	DSP and Embedded Systems	EE703	4	0	0		100		
5	Power System Planning	EE704	3	0	0		100		
6	Elective I (Dept)	EE705/d	4	0	0		100		
7	Elective-II (Dept)	EE706/d	2	0	0		50		
8	Power Electronics & Instrumentation Lab	EE751	0	0	4			100	
9	Power System Planning Sessional	EE752	0	0	2			50	
10	Elective II Lab	EE753/d	0	0	3			50	
11	Project Preliminary	EE754	0	0	3			50	
12	Industrial Traning and Report #	EE771	0	0	0			50	
13	Viva Voce-III	EE772	0	0	0			50	
		Total:	23	0	12	35	600	350	950
	# 30 days Training								
	8th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Industrial Management	ME806	4	0	0		100		
2	Utilization of Electric Power	EE801	3	0	0		50		
3	Switch Gear and Protective Relay	EE802	4	0	0		100		
4	Special Machines & Drives	EE803	4	0	0		100		
5	Elective III (Non-deptt/Dept.)	XX80n/d/EE804/d	2	0	0		50		
6	Elective IV (Dept)	EE805/d	3	0	0		100		
7	Industrial Electronics & Drives Lab	EE851	0	0	4			100	
8	Protective Relay Lab	EE852	0	0	2			50	
9	Elective IV Lab	EE853/d	0	0	2			50	
10	Project & Thesis	EE854	0	0	5			150	
11	Viva Voce-IV	EE871	0	0	0			50	
		Total:	20	0	13	33	500	400	900

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Electronics and Telecommunication Engineering

	3rd Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Mathematics-IIIB	MA302	3	1	0		100		
2	Electrical Measuring Instruments	EE304	4	0	0		100		
3	Signals and Systems	ET301	3	1	0		100		
4	Network theory	ET302	3	1	0		100		
5	Electronic Devices	ET303	3	1	0		100		
6	Analog Electronics	ET304	3	1	0		100		
7	Electrical Measuring Instruments Lab.	EE354	0	0	3			50	
8	Network theory Lab.	ET351	0	0	3			50	
9	Electronic Devices and Circuits Lab.	ET352	0	0	4			100	
		Total:	19	5	10	34	600	200	800
	4th Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Mathematical Techniques	MA401	3	1	0		100		
2	Analog Communication	ET401	3	1	0		100		
3	Digital Electronics	ET402	3	1	0		100		
4	Microelectronics	ET403	3	1	0		100		
5	Electromagnetic Theory and Radio Wave Propagation	ET404	3	1	0		100		
6	Numerical Analysis & Computer Programming	ET405	3	0	0		100		
7	Analog Communication Lab.	ET451	0	0	3			50	
8	Digital Electronics Lab.	ET452	0	0	3			50	
9	Microelectronics Lab.	ET453	0	0	3			50	
10	Numerical Analysis & Computer Programming Lab.	ET454	0	0	3			50	
		Total:	18	5	12	35	600	200	800

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Electronics and Telecommunication Engineering

	5th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Digital Communication	ET501	3	1	0		100		
2	Integrated Circuits & Systems	ET502	3	1	0		100		
3	Microprocessor	ET503	3	0	0		100		
4	Transmission Lines & Wave-guides	ET504	3	1	0		100		
5	Electronic Measurement & Instrumentation	ET505	3	0	0		100		
6	Data Structure & Computer Organisation	ET506	3	0	0		100		
7	Digital Communication Lab.	ET551	0	0	3			50	
8	Intregated Circuits & Systems Lab.	ET552	0	0	3			50	
9	Microprocessor Lab.	ET553	0	0	2			50	
10	Transmission Lines & Wave-guides Lab.	ET554	0	0	3			50	
11	Electronic Measurement & Instrumentation Lab.	ET555	0	0	3			50	
12	Viva -Voce-I	ET571	0	0	0			50	
		Total:	18	3	14	35	600	300	900
	6th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Economics & Accountancy	HU5601	2	0	0		50		
2	Principles of Management	HU5602	2	0	0		50		
3	Microwave & Radar Engineering	ET601	3	1	0		100		
4	Advanced Microprocessors & Computer Arch.	ET602	3	0	0		100		
5	System Software	ET603	3	0	0		100		
6	Audio & Video Engineering	ET604	3	0	0		100		
7	Antenna Engineering	ET605	3	1	0		100		
8	Microwave & Radar Engineering Lab.	ET651	0	0	3			50	
9	Advanced Microprocessors Lab.	ET652	0	0	3			50	
10	System Software Lab.	ET653	0	0	3			50	
11	Audio & Video Engineering Lab.	ET654	0	0	3			100	
12	GroupDiscussion and Seminar	ET655	0	0	2			50	
13	Viva Voce-II	ET671	0	0	0			50	
		Total:	19	2	14	35	600	350	950

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Electronics and Telecommunication Engineering

	7th. Semester							
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**
1	Professional values and ethics	HU7801	2	0	0		50	
2	Power Electronics	ET701	3	1	0		100	
3	Control System	ET702	3	1	0		100	
4	Electronic Design Automation	ET 703	3	1	0		100	
5	Dgital Signal Processing	ET704	3	1	0		100	
6	Wireless and Mobile Communication	ET705	3	1	0		100	
7	Elective I (Dept)	ET706/d	3	1	0		100	
8	Power Electronics and Control System Lab	ET751	0	0	3			100
9	Electronic Design Automation Lab	ET752	0	0	3			50
10	Dgital Signal Processing Lab	ET753	0	0	3			50
11	Project Priliminary	ET754	0	0	2			50
12	Viva -Voce-III	ET771	0	0	0			50
		Total:	20	6	11	37	650	300
	8th. Semester							
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**
1	Optoelectronics & Optical Communication	ET801	3	1	0		100	
2	Computer Network & Communication	ET802	3	1	0		100	
3	Telecommunication Swiching	ET803	3	1	0		100	
4	Elective II (Dept.)	ET804	3	1	0		100	
5	Elective III (Non-Dept/Dept.)	XX80n/d/ET805/d	2	0	0		50	
6	Optoelectronics & Optical Communication Lab	ET851	0	0	3			100
7	Swiching & Computer Networking Lab	ET852	0	0	3			50
8	Elective II Lab	ET853/d	0	0	3			50
9	Project Thesis & Viva Voice	ET854	0	0	6			150
10	Viva Voce-IV	ET871	0	0	0			100
		Total:	14	4	15	33	450	450

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Computer Science and Technology

	3rd. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Mathematics IIIC	MA303	3	1	0		100		
2	Electrical Machines and Applications	EE305	3	0	0		100		
3	Elements of Mechanical Engg.	ME304	2	1	0		50		
4	Electronic Devices and Circuits	ET305	3	1	0		100		
5	Digital Logic	CS301	3	1	0		100		
6	Data Structures and Algorithms	CS302	3	1	0		100		
7	Electrical Machines & Applications Lab.	EE355	0	0	3			50	
8	Electronic Devices & Circuits Lab.	ET352	0	0	4			100	
9	Data Structures Algorithms Lab.	CS351	0	0	3			50	
10	Digital Logic Lab.	CS352	0	0	4			50	
		Total:	17	5	14	36	550	250	800
	4th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Probability & Statistics	MA402	3	1	0		100		
2	Control & Instrumentation	EE406	4	0	0		100		
3	Discrete Structures	CS401	3	1	0		100		
4	Computer Organisation	CS402	3	1	0		100		
5	Object Oriented Technology	CS403	3	1	0		100		
6	Electronic Design Automation	CS404	2	1	0		50		
7	Object Oriented Technology Lab.	CS451	0	0	3			50	
8	Electronic Design Automation Lab.	CS452	0	0	3			50	
9	Computer Organisation Lab.	CS453	0	0	4			100	
10	Discrete Structures Lab.	CS454	0	0	3			50	
		Total:	18	5	13	36	550	250	800

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Computer Science and Technology

	5th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Mathematics-V	MA501	3	1	0		100		
2	Operating Systems	CS501	3	1	0		100		
3	Computer Architecture	CS502	3	1	0		100		
5	Microprocessor based System design	CS503	3	1	0		100		
6	Design & Analysis of algorithm	CS504	3	1	0		100		
7	Digital Communication	ET501	3	1	0		100		
8	Operating Systems Lab.	CS551	0	0	3			100	
9	Algorithm Lab.	CS552	0	0	2			50	
10	Microprocessor based System design Lab.	CS553	0	0	4			100	
11	Digital Communication Lab	ET551	0	0	3			50	
		Total:	18	6	12	36	600	300	900
	6th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Economics & Accountancy	HU5601	2	0	0		50		
1	Principles of Management	HU5602	2	0	0		50		
2	Analysis, Design & Mgmt.of Info. Systems	CS601	3	1	0		100		
3	Theory of Computation	CS602	3	1	0		100		
4	Computer Networks	CS603	3	1	0		100		
5	Database Management System (DBMS)	CS604	3	1	0		100		
6	System Programming	CS605	3	1	0		100		
7	Anal., Design & Mgmt.of Info. Systems Lab.	CS651	0	0	2			50	
8	Database Management System Lab	CS652	0	0	2			50	
9	Computer Networks Lab.	CS653	0	0	3			50	
10	System Programming Lab.	CS654	0	0	3			50	
11	Digital Systems Design Lab.	CS655	0	0	4			100	
12	Viva Voce-I	CS671	0	0	0			50	
		Total:	17	5	14	36	600	350	950

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Computer Science and Technology

	7th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Professional values and ethics	HU7801	2	0	0		50		
2	Computer Graphics	CS701	3	1	0		100		
3	Comp.Control of Industrial Processes	CS702	3	1	0		100		
4	Compiler Design	CS703	3	1	0		100		
5	VLSI Design	CS704	3	1	0		100		
6	Elective I (Dept)	CS705/d	3	1	0		100		
7	Elective II (Dept)	CS706/d	3	1	0		100		
8	Computer Graphics Lab	CS751	0	0	3			100	
9	Comp. Control of Industrial Process Lab	CS752	0	0	3			50	
10	Compiler Design Lab	CS753	0	0	3			50	
11	Project Preliminary / Thesis	CS754	0	0	2			50	
12	Viva - Voce II	CS771	0	0	0			50	
		Total:	20	6	11	37	650	300	950
	8th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Management in Industries	ME806	2	0	0		50		
2	Software Engineering	CS801	3	1	0		100		
3	Symbolic Logic & Artificial Intelligence	CS802	3	1	0		100		
4	Elective III (Non-Dept / Dept)	XX80n/d/CS803/d	2	0	0		50		
5	Elective IV	CS804/d	3	1	0		100		
6	Symbolic Logic & Algorithm Lab	CS851	0	0	3			50	
7	VLSI Lab	CS852	0	0	3			50	
8	Software Engineering Lab	CS853	0	0	3			50	
9	Project / Thesis	CS854	0	0	6			200	
10	Group Discussion / Seminar	CS855	0	0	2			50	
11	Viva Voce-III	CS871	0	0	0			100	
		Total:	13	3	17	33	400	500	900

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	3rd. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Mathematics IIIB	MA302	3	1	0		100		
2	Numerical Analysis and Functional Optimization	IT301	3	1	0		100		
3	Algorithms and Data Structure	IT302	3	1	0		100		
4	Discrete Mathematics	IT303	2	0	0		50		
5	Graph Theory & Application	IT304	2	0	0		50		
6	Digital Circuits and Logic Design	IT305	3	1	0		100		
7	Num Analysis & Functional Optimization Lab.	IT351	0	0	3			50	
8	Advanced C Programming Lab.	IT352	0	0	3			50	
9	Data Structure Lab.	IT353	0	0	6			100	
10	Digital Circuits and Logic Design Lab.	IT354	0	0	3			100	
		Total:	16	4	15	35	500	300	800
	4th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Operation Research	MA403	2	1	0		50		
2	Computer Organisation & Architecture	IT401	3	1	0		100		
3	Operating System	IT402	3	1	0		100		
4	Signals & Systems	IT403	3	1	0		100		
5	Formal Language & Automata Theory	IT404	3	1	0		100		
6	Computer Aided Graphics	IT405	3	1	0		100		
7	Operation Research Lab.	MA451	0	0	3			50	
8	Computer Organisation & Architecture Lab.	IT451	0	0	3			50	
9	Operating Systems Lab.	IT452	0	0	3			100	
10	Computer Aided Graphics Lab.	IT453	0	0	3			50	
		Total:	17	6	12	35	550	250	800

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5th. Semester								
Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
Communication System	IT501	3	1	0		100		
Microprocessors	IT502	3	1	0		100		
Database Management System	IT503	3	1	0		100		
Systems Programming	IT504	3	0	0		100		
Objected Oriented Methodology & Programming	IT505	3	0	0		100		
Analysis & Design of Algorithms	IT506	2	0	0		50		
Communication System Lab.	IT551	0	0	3			50	
Microprocessors Lab.	IT552	0	0	3			100	
Database Management System Lab.	IT553	0	0	3			100	
Objected Oriented Programming Lab.	IT554	0	0	3			100	
	Total:	17	3	12	32	550	350	900
6th. Semester								
Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
Economics & Accountancy	HU5601	2	0	0		50		
Principles of Management	HU5602	2	0	0		50		
Computer Networks	IT601	3	1	0		100		
Telecommunication Systems	IT602	2	1	0		100		
Multimedia Systems	IT603	3	1	0		100		
Digital Signal Processing	IT604	3	1	0		100		
Advanced Computing Architecture	IT605	3	1	0		100		
Computer Networks Lab.	IT651	0	0	3			100	
Multimedia Systems Lab.	IT652	0	0	3			100	
Digital Signal Processing Lab.	IT653	0	0	3			50	
Systems Programming Lab.	IT654	0	0	3			50	
Viva Voce-I	IT671	0	0	0			50	
	Total:	18	5	12	35	600	350	950

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	7th. Semester							
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**
1	Professional values and ethics	HU7801	2	0	0		50	
2	Software Engineering	IT701	3	1	0		100	
3	Distributed Computing	IT702	3	1	0		100	
4	Broadband Communication	IT703	3	1	0		100	
5	Web Technology	IT704	3	1	0		100	
6	Elective I (Dept)	IT705/d	3	1	0		100	
7	Software Engineering Lab	IT751	0	0	3			100
8	Distributed Computing Lab	IT752	0	0	3			100
9	Web Technology Lab	IT753	0	0	3			100
10	Project Priliminiary	IT754	0	0	3			50
11	Viva - Voce II	IT771	0	0	0			50
		Total:	17	5	12	34	550	400
	8th. Semester							
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**
1	Image Processing and Pattern Recognition	IT801	3	1	0		100	
2	Artificial Intelligence	IT802	3	1	0		100	
3	Mobile Computing	IT803	3	1	0		100	
4	Elective II (Dept.)	IT804/d	3	1	0		100	
5	Elective III(Non Dept./ Dept.)	XX80n/d/IT805/d	2	0	0		50	
6	Image Processing and Pattern Recognition Lab	IT851	0	0	3			100
7	Artificial Intelligence Lab	IT852	0	0	3			50
8	Elective II Lab	IT853/d	0	0	3			50
9	Project & Thesis	IT854	0	0	6			150
10	Viva Voce-III	IT871	0	0	0			100
		Total:	14	4	15	33	450	450

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COURSE STRUCTURE FOR THE BACHELOR OF ARCHITECTURE

	1st Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	English for Engineers	HU101A	2	1	0		50		
2	Mathematics – IA	MA101A	3	1	0		100		
3	Engineering Mechanics	AM101A	3	1	0		100		
4	Design Fundamentals	AR101	3	0	0		100		
5	Materials and Methods of Construction – I	AR102	3	0	0		100		
6	Descriptive Geometry (3 hrs. Exam.)	AR103	1	0	0		50		
7	Workshop Practice	WS151A	0	0	3			100	
8	Architectural Delineation	AR151	0	0	3			100	
9	Basic Design	AR152	0	0	6			150	
10	Descriptive Geometry & Modelling Practice – I	AR153	0	0	6			150	
		Total:	15	3	18	36	500	500	1000
	Additional Elective								
	NCC / Physical Training-I	SA191A	0	0	2			50	
	(for Architechture only)								
		(Marks obtained more than the Pass Marks will be added to theTotal)							

	2ND semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Mathematics – IIA	MA201A	3	1	0		100		
2	Environment and Ecology	CE201A	2	0	0		50		
3	Strength of Materials	AM201A	3	1	0		100		
4	Evolution of Architecture – I	AR 201	3	0	0		100		
5	Materials and Methods of Construction – II	AR 202	3	0	0		100		
6	Architectural Design & Descriptive Geometry (6 hrs. exam.)	AR 203	2	0	0		100		
7	Architectural Design & Drawing	AR251	0	0	6			150	
8	Descriptive Geometry & Modelling Practice–II	AR252	0	0	6			150	
9	Details of Construction Practice – I	AR253	0	0	4			150	
		Total:	16	2	16	34	550	450	1000
	Additional Elective								
	NCC / Physical Training-II	SA291A	0	0	2			50	
	(for Architechture only)								
		(Marks obtained more than the Pass Marks will be added to theTotal)							

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	3rd. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Theory of Structure-I	CE 301A	3	1	0		100		
2	Surveying	CE 302A	2	0	0		50		
4	Evolution of Architecture-II	AR 301	3	0	0		100		
5	Materials and Methods of Construction -III	AR 302	3	0	0		100		
6	Climatology	AR 303	2	0	0		50		
3	Plumbing Services	AR 304	2	0	0		50		
7	Architectural Design-I (6 hrs. Exam.)	AR 305	1	0	0		100		
8	Architectural Design Practice-I	AR 351	0	0	8			150	
9	Details of Construction Practice -II	AR 352	0	0	3			100	
10	Computer Practice-I	AR 353	0	0	3			100	
11	Climatology Practice	AR 354	0	0	2			50	
12	Educational Tour & Documentation-I #	AR 371	0	0	0			50	
		Total:	16	1	16	33	550	450	1000
	# 10days at the beginning of the semester								
	4th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Theory of Structure-II	CE 401A	2	1	0		100		
2	Electrical Services	EE 401A	2	0	0		50		
3	Evolution of Architecture-III	AR 401	3	0	0		100		
4	Materials & Methods of Construction-IV	AR 402	3	0	0		100		
5	Landscape and Site Planning	AR 403	3	0	0		100		
6	Architectural Design-II (6 hrs. Exam.)	AR 404	1	0	0		100		
7	Architectural Design Practice-II	AR 451	0	0	9			150	
8	Details of Construction Practice -III	AR 452	0	0	4			100	
9	Computer Practice-II	AR 453	0	0	3			100	
10	Landscape Practice	AR 454	0	0	3			50	
11	Survey Practice #	CE 471A	0	0	0			50	
		Total:	14	1	19	34	550	450	1000
	# 10days at the beginning of the semester								

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	5th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Professional Values & Ethics	HU 501A	2	0	0		50		
2	Structural Engineering – III	CE 501A	2	1	0		100		
3	Mechanical Services	ME 501A	2	0	0		50		
4	Contemporary Architecture-I	AR 501	3	1	0		100		
5	Materials & Methods of Construction-V	AR 502	3	0	0		100		
6	Architectural Design-III (12 hrs. Exam.)	AR 503	1	0	0		100		
7	Architectural Design Practice-III	AR 551	0	0	11			250	
8	Working Drawing - I	AR 552	0	0	4			100	
9	Computer Practice-III	AR 553	0	0	4			100	
10	Educational Tour & Documentation-II #	AR 571	0	0	0			50	
		Total:	13	2	19	34	500	500	1000
	# 12days at the beginning of the semester								
	6th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Structural Engineering – IV	CE 601A	2	1	0		100		
2	Contemporary Architecture-II	AR 601	3	1	0		100		
3	Materials & Methods of Construction-VI	AR 602	3	0	0		100		
4	Architectural Acoustics	AR 603	2	0	0		50		
5	Estimation & Specification of Properties	AR 604	2	0	0		50		
6	Architectural Design – IV (12 hrs. Exam.)	AR 605	1	0	0		100		
7	Architectural Design Practice-IV	AR 651	0	0	11			250	
8	Working Drawing-II	AR 652	0	0	4			100	
9	Computer Practice-IV	AR 653	0	0	4			100	
10	Estimation Practice	AR 654	0	0	3			50	
		Total:	13	2	22	37	500	500	1000

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	7th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Architectural Training #	AR 771	0	0	0		500		
		Total:					500		500
	# 24 weeks in the semester								
	8th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Earthquake Resistant Architecture	CE 801A	2	1	0		50		
2	Principles of Human Settelment	AR 801	3	0	0		100		
3	Housing	AR 802	3	0	0		100		
4	Valuation of Properties	AR 803	2	0	0		50		
5	Structural System	AR 804	2	0	0		100		
6	Architecture Design - V (12 Hrs. Exam)	AR 805	1	0	0		100		
7	Material Testing Laboratory	AM 851A	0	0	4			100	
8	Architecture Design Practice-V	AR 851	0	0	14			300	
9	Municipal Drawing	AR 852	0	0	4			100	
		Total:	13	1	22	36	500	500	1000

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	9th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Principles of Management	HU 901A	2	0	0		50		
2	Project Management	AR 901	2	0	0		50		
3	Interior Design	AR 902	2	0	0		50		
4	Urban Design	AR 903	2	0	0		50		
5	Architectural Conservation	AR 904	2	0	0		50		
6	Planning Techniques	AR 905	2	0	0		50		
7	Elective-I *	AR 906	2	0	0		50		
8	Architecture Design-VI (18 hrs.Exam)	AR 907	0	0	0		100		
9	Architectural Project	AR 951	0	0	15			400	
10	Interior Design Practice	AR 952	0	0	3			50	
11	Elective - II †	AR 953	0	0	3			50	
12	Architectural Research Methods & Dissertation Programming	AR 954	0	0	2			50	
		Total:	14	0	23	37	450	550	1000
	10th. Semester								
	Name of the subject	**Subject Code**	**L**	**T**	**S**	**Tot**	**Full**	**Marks**	**Total**
1	Professional Practice & Entrepreneurship	AR 1001	4	0	0		100		
2	Elective – III ‡	AR 1002	3	0	0		100		
3	Project Dissertation	AR 1051	0	0	0			700	
4	Grand Viva-Voce	AR 1071	0	0	0			100	
		Total:	7	0	0	7	200	800	1000
	Elective-II**								
01	Energy Building	AR 1002/01							
02	Intelligent Building	AR 1002/02							
03	Transportation Architecture	AR 1002/03							
04	Facility Programming and Post Occupancy								
	Evaluation	AR 1002/04							

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PART - II

SYLLABI :

THE BACHELOR OF ENGINEERING AND THE BACHELOR OF ARCHITECTURE

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DEPARTMENT OF APPLIED CHEMISTRY

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DEPARTMENT OF APPLIED CHEMISTRY

APPROVED SYLLABUS for UNDERGRADUATE (B.E.) COURSE

CH 1201 CHEMISTRY (for all Engg. Branches)

SEMESTER EXAMINATION: **CONTRACT PERIODS: (3 L + I T)**
TIME – 3Hrs. **Continious Assessment :**
Full Marks -70 **Full Marks -30**

Unit 1: Structure and Reactivity of Organic Molecules:

Inductive effect; resonance; hyper conjugation; electromeric effect; carbocation, carbanion and free radicals. Brief study of some addition, climination and substitution reaction. Conformational analysis (acyclic and cyclic molecules); geometrical and optical isomerisation; E,Z and R,S nomenclature.
8L

Unit 2: Spectroscopic Techniques:

Experimental methods of structure determination using spectroscopic such as UV-VIS, IR.

6L

Unit 3: Atomic Structure:

Schrodinger equation; well behaved function; particle in a box, H-atom: radial and angular distribution function.
8L

***Unit 4: Reaction Dynamics*:**

Rate laws, mechanism and theories of reaction rates (Collision and Transition state theory).
6L

Unit 5: Electrochemistry :

Ionic conductance and its applications; electrode potential and its application to predict redox reactions; structure of electrode / electrolyte interface. 8L

Unit 6: Polymerization

Basic concepts, classification and industrial applications 3L

Unit 7: Solid State Chemistry

Idea of spatial periodicity of lattces, elements of band theory, conductors, semi conductors and insulators.
5L

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CH 1251 CHEMISTRY LABORATORY (for all Engg. Branches)

Full Marks – 50. Contact Periods : (3S)

Laboratory experiments are recommended based on the course **CHEMISTRY (CH 1201)**

CH401 Instrumental Chemical Analysis (for Met.E)

Semester Examination : Contact Periods : (2L+ 1 T)

Time-2 hrs. **Internal Assessment :**

Full Marks – 35. **Full Marks – 15.**

Basic concept of dry and wet analysis, Principles of precipitation reaction, redox reaction (elementary idea of redox potential and its application), Redox indicator, Principles and application of conductometry, Potentionmetry, voltametry, polarography, Spectrophotometry, (UV-visible & Infra red), Atomic absorption spectrophotometry, Moss Baur and Magnetic resonance spectrometry.

CH451 Instrumental Chemical Analysis Lab (for Met.E)

(Sessional Subject)

Full Marks – 100. Contact Periods : 4S

Experiments based on the subject Instrumental Chemical Analysis (CH 401)

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DEPARTMENT OF APPLIED GEOLOGY

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DEPARTMENT OF APPLIED GEOLOGY

APPROVED SYLLABUS for UNDERGRADUATE (B.E.) COURSE

GE 301 ENGINEERING GEOLOGY (for CE)

Semester Examination : Contact Periods : (3L+ 1 T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 70. **Full Marks – 30.**

Physical geology- Weathering, Erosion, Transportation, Deposition,Geological Agents. Overall ideas about the work done by Geological Agents. The Earth- Origin, age,internal constitution. Geological timescale- a brief introduction.

Mineralogy – Definition of Minerals, Non-crystalline, Crystalline matter and Crystals. Physical Properties of Minerals in general. An Introduction to physical properties of Common Rock Forming Minerals and Economic Minerals.

Petrology- Definition of Rocks. Brief idea on different types of Rocks. Igneous Rocks- forms, structures and textures. Sedimentary Rocks- Genesis, Texture, Classification. Metamorphic Rocks – Factors controlling Metamorphism, Textures and Structures of Metamorphic Rocks. Petrography of : Granite, Basalt, Diorite, Granodiorite, Gabbro, Rhyolite, Pegmatite, Anorthosite, Sandstone, Shale, Conglomerate, Limestone, B.I.F, Micaschist, Gneiss, Quartzite.

Structural Geology – Brief idea about fold, fault, unconformity, lineation, foliation.

Geohydrology – Sources of Ground water, Hydrological Zones below the surface, porosity, permeability, aquifer-confined and unconfined, engineering importance of ground water study.

Engineering Geology – Importance of geological investigation in engineering projects, site selection for dam, bridge, tunnel & reservoir, stability of hill slopes along road and railway cuttings.

GE401 Introduction of Geology (for MN)

Semester Examination : Contact Periods : (3L+ 1 T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 70. **Full Marks – 30.**

Physical geology- Weathering, Erosion, Transportation, Deposition,Geological Agents. Overall ideas about the work done by Geological Agents. The Earth- Origin, age,internal constitution. Geological timescale- a brief introduction.

Mineralogy – Definition of Minerals, Non-crystalline, Crystalline matter and Crystals. Physical Properties of Minerals in general. An Introduction to physical properties of Common Rock Forming Minerals and Economic Minerals.

Petrology- Definition of Rocks. Brief idea on different types of Rocks. Igneous Rocks- forms, structures and textures. Sedimentary Rocks- Genesis, Texture, Classification. Metamorphic Rocks – Factors controlling Metamorphism, Textures and Structures of Metamorphic Rocks. Petrography of : Granite, Basalt, Diorite, Granodiorite, Gabbro, Rhyolite, Pegmatite, Anorthosite, Sandstone, Shale, Conglomerate, Limestone, B.I.F, Micaschist, Gneiss, Quartzite.

Structural Geology – Brief idea about fold, fault, unconformity, lineation, foliation.

Geohydrology – Sources of Ground water, Hydrological Zones below the surface, porosity, permeability, aquifer-confined and unconfined, engineering importance of ground water study.

Economic Geology – Origin of ore deposits- magmatic, hydrothermal, sedimentary processes of ore formation. Brief description of the common ores of oxides, sulphides and silicates, distribution of metallic & non-metallic ores in India.

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GE451 Introduction of Geology Lab (for MN)
(Sessional Subject)

Full Marks – 50. Contact Periods : 2S

Measurement of dip, strike Structural problems related to fold, fault and unconformity. Identification of common rocks and minerals, ores in hand specimen.

Study of rock forming minerals & ores in hand specimen

GE501	**L**	**T**	**S**
Mining Geology (for MN)	**3**	**1**	**0**

Economic geology – principles, metallic and non-metallic deposits
Structural geology
Ground water
Geology of tunnel site

GE551	**L**	**T**	**S**
Mining Geology Lab (for MN)	**0**	**0**	**2**

(Sessional Subject)

Study of rocks (igneous, sedimentary & metamorphic) in hand specimen
Study of common rocks in thin section

GE 601	**L**	**T**	**S**
Stratigraphy & Paleontology (for MN)	**3**	**1**	**0**

Principles of stratigraphy and Indian stratigraphy
Outlines of paleontology

GE 651	**L**	**T**	**S**
Stratigraphy & Paleontology Lab (for MN)	**0**	**0**	**2**

Study of contours pattern
Dip problems
Maps – study of homoclinal beds, folds, faults & unconformity

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DEPARTMENT OF APPLIED MATHEMATICS

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DEPARTMENT OF APPLIED MATHEMATICS

APPROVED SYLLABUS for UNDERGRADUATE (B.E.) COURSE

MA 101 MATHEMATICS-I (for all Engg. Branches)

SEMESTER EXAMINATION: **CONTRACT PERIODS: (3 L + I T)**
TIME – 3Hrs. **Continious Assessment :**
Full Marks -70 **Full Marks -30**

Calculus (First half : A and B ; Second half: C and D

Function of Single Variable:

Successive Differentiation, Rolle's Theorem (statement only). Geometrical Interpretation, MVT, Geometrical Interpretation, Taylor's Theorem, Cauchy & Lagrange's form of reminders, Taylor's and Maclaurin's series, expansion of function, Indeterminate forms.

Application of Calculus: Intrinsic and Pedal equation of curves, Curvature, Asymptote.

Test of Convergence of Infinite Series:
Comparison test, D Alenbert's Ratiotest, Gauss test and Cauchy's Root test, Power series.

Functions of Several variables:
Limit, Continuity, Differentiability (definition and sample examples only), Partial derivatives, Differentials & small errors, Euler's theorem, Taylor's theorem & series,Expansion of functions, Maxima &minima.

Complex Algebra:

De Moivre's theorem, Extraction of roots of complex numbers, complex functions, e.g., a^z and sin z, cos z, log z, $\sin^{-1}z$, $\cos^{-1}z$, $\tan^{-1}z$ etc.

MA 201 MATHEMATICS -II (for all Engg. Branches)

SEMESTER EXAMINATION: **CONTRACT PERIODS: (3 L + I T)**
TIME – 3Hrs. **Continious Assessment :**
Full Marks -70 **Full Marks -30**

First half : A and B ; Second half: C and D

Calculus:
Fundamental an MVT of Intigral Calculus,(sStatement only), Improper Integrals, Beta and Gamma Functions, MultipleIntegrals and Applications.

Vector Analysis
Sum and product of vectors, Vector equations of lines and planes, Derivative of a vector, Differential Geometry upto Serret – Frenet's formula, Directional Derivations, Gradient, divergence, Curl, Line integral and surface integral, Green, Gauss and Stokes'ems, Application of vector to Geometry and Mechanics

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Maxtrix and Determinant:

Definition and simple properties regarding sum and product of two matrices, Transpose, Symmetric, Skew-Symmetric and orthogonal matrics, Determinant of sq. matrics & their simple properties, co-factors & minors, Left and right inverse, Rank of matrics, Eigen-values and Eigen-vectors, similar matrics, Diagonalisation of matrics, Solution of simultaneous linear equations: Consistency & Inconsistency.

Differential Equations:

Higher order linear ODE with constant co-efficients, method of variation of parameters, Cauchy or Euler's equations, Frobenious method of solution in series of ODE, Singular points, Bassel and Legendre equations, Rodrigue's Formula, Recurrence relations and Orthogonality relations

MA 301 MATHEMATICS III A (for CE/ME/MN/MT)

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Group I:

A. Complex variables: Function, Limit and continuity of complex functions, Differentiation of complex functions, Analytic function, Cancly-Riemann equations, Harmonic functions, Line Integrates, Canchy-Gourset theorem (No proof required). Cancly's Integral formula, Derivative of analytic functions, Taylor's and Laurent's series, Zeroes, Singular points: essential and removable, Poles, Residue, Residue Theorem, Contour Integration (simple cases only)

B. Fouries Series :

C. Boundary value and Initial value problems leading to partial differential Equation: Method of solution by separation of variables Technique.

Group II: L.P.P.

Vector and Euclidean spaces, Linea dependence, Bases, Vector space and subspaces, Rank, Point sets, Convex sets, Boundary Points, Extreme points, Linear system – Basic Solutions, Basic matrix, Feasible solution, Basic feasible solution, Linear programming problems, Slack surplus and artificial variables, Graphical method of solution, Simplex method, Charne's Big-M-method.

MA 302 MATHEMATICS III B (for EE/ET/IT)

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

A. Probability : Intuitive notion, Classical definition of probability, Combinatorial application, Axiomatic approach to probability theory, Univariate probabilities distributions – discrete and continuous. Standard distributions – Binomial, Poisson, Normal and Exponential. Bivariate distributions – concept of joint and conditional distributions. Mathematical expectation, Variance and Covariance. Correlation coefficients.

B. Statistics : Point estimation and interval estimation. Concept of statistics. Unbiasedness and mean square error. Minimum variance unbiased estimators. Testing of Hypothesis.

C. Queuing Theory : Homogeneous Poisson Process (HPP), Notion of a queuing system, Kendall's notation, M/M/1, M/M/C, M/M/ ∞ queues. Steady state distributions. M/G/ ∞ queue and related special cases.

D. Linear programming : concept of LPP and its dual formulation, basic solutions, feasible solutions and basic feasible solutions, convex sets. Notions of optimal solutions and relations and relation to corner points. Graphical approach. Basic theorems and complementary slackness conditions. Simplex method.

MA 303 MATHEMATICS III C (for CS)

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Group – I

A. Complex variables

Function, limit and continuity of complex functions, differentiation of complex functions, analytic function, Cauchy – Riemann equations, Harmonic functions, Line integrals, Cauchy – Gourset Theorem, Derivative of analytic functions, Taylor's and Laurent's series, Zeroes, Singular points, essential and removable, Poles, Resudue, Residue Theorem, Contour Integration (Simple cases only).

B. Fourier series.

C. Boundary value and Initial value problems leading to partial differential equation, Method of solution by separation of variables Technique.

Group – II : Discrete Structures

A. Algebraic Structures: Monoids, Groups, Subgroups, Homomorphism, Isomorphism, Automorphism, Cosets, Lagrange's Thearem, Elementary ideas of Ring and Field.

Graph Theory: Graph, Incidence and Degree, Walks, Paths and circuits, Euler graph, Tree, Spanning tree, Fundamental circuit, cut sets and cut vertices.

MA 305: PROBABILITY, STATISTICS AND QUEING THEORY

FM – 100 Contact Period : 4L+1T per week

Probability

Random experiments, Events and Event space, Classical definition of probability, statistical regularity and frequency definition of probability, Axioms of probability and associated basic formulas, Conditional probability, Bayes' theorem.

Independent trials, Bernoulli trials, Poisson approximate, Random variables, Probability distributions for univariate random variables – discrete and continuous, Expectations, Moment generating function and Characteristic function, Bivariate random variable, marginal and conditional distributions, Expectation for a bivariate distribution, Correlation and regression.

Special Distributions e.g. χ^2, t, F – distributions.
Inequalities and Limited theorems including the Central Limit theorem (statement only).

Statistics

Random samples and Sample characteristics, Sampling distributions.
Estimation of parameters: point estimation – method of Maximum Likelihood, Interval estimation.
Testing of hypotheses: best critical region, Neyman – Pearson theorem (statement only), Applications to Normal (m, σ) population, - χ^2 test for goodness of fit.

Queing Theory

Classification of Stochastic Processes, Markov chains, Transition Probability matrices, Chapman-Kolmogorov equations and applications. Simple Random Walk-recurrence

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and transience.
Poisson Process. Structures and Components of a Queing System, Kendall's notation.

Basic queing models: the M/M/I, M/M/c, M/M/∞ , $M^{(b)}$ /M/1 and M/G/∞ queues-
transient and steady state solutions.

MA401 Mathematical Techniques (for ETC)

Semester Examination : Contact Periods : (3L+ 1 T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 70. **Full Marks – 30.**

A. **Matrix Theory** - Partition of a matrix, Eigen values, Eigen vectors of various types of matrices, Properties of matrices, Similarity and Orthogonal transformation. Diagonalization and triangularization. Quadratic form and reduction to orthogonal transformation and Applications.

B. Fourier transform, fourier sine and cosine transform.

C. Laplace Transform, Transform of elementary functions, Convolution Theorem, Inverse transform, z transform

D. Calculus of Variation: Euler lagrange differential equation for fixed end points, Application to Brachistochrone problem, Euler Lagrange equation for variable end points.

MA402 Probability & Statistics (for CS)

Semester Examination : Contact Periods : (3L+ 1 T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 70. **Full Marks – 30.**

Group A

Probability : Intuitive notion, Classical definition of probability, Combinatorial applications, Axiomatic approach to probability theory.

(i) Probability distributions - Discrete and continuous, Bivariate distributions – concept of joint and conditional distributions, Standard distributions – Binomial, Poisson, Negative Binomial, Geometric, Hypergeometric, Uniform, Normal, Multivariate Normal, Exponential, Weibull. Chi-square distribution, t, F, Z distributions. Central Limit Theorem and its applications.

(ii) Mathematical expectation, Variance and Covariance. M.G.F and C.F. of standard distributions. Cauchy-Schwartz, Jenson, Chebychev's inequalities. WLLN, SLLN.

(iii) Correlation and Regression, Principle of least squares and curve fitting.

Group B

(i) Measures of Central Tendency, Dispersion, Skewness and Kurtosis.

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(ii) Estimation: Point estimation and Interval estimation, Properties of good estimators- Unbiasedness, Consistency, Efficiency and sufficiency, Methods of estimation- MLE, Methods of Moments, Minimum variance unbiased estimators.

(iii) Testing of Hypothesis: Types of Hypothesis, Critical region, Types of Errors, Level and power of Test, MP test, likelihood test, Neymann-Person Lemma and its applications.

MA403 Operation Research (for IT)

Semester Examination : Contact Periods : (2L+ 1 T)

Time-2 hrs. **Internal Assessment :**

Full Marks – 35. **Full Marks – 15.**

1. Duality and dual-simplex method:- Concept of duality, Mathematical formulation of duals, Duality theorems, Complementary slackness duality and simplex method, Economic interpretation of duality. Computational procedure of the dual-simplex algorithm, Examples.
2. Sensitivity Analysis :- Introduction, Changes in the objective functions. Variation in the requirement vector. Addition and deletion of a variable. Addition of a constraint.
3. Integer linear Programming :- Introduction, Cutting plane algorithm for pure integer solution, The branch and bounds technique.
4. Assignment Problems :- Mathematical formulation of the problem solution of assignment problem, computational procedure. Variations in assignment problem, Travelling salesman problem.
5. Sequencing :- Introduction. Terminology, Notations and assumption, Problems with n-jobs and 2-machines. Problems with n jobs and 3 machines and problems with n-jobs and n-machines. Optimum sequencing algorithm.
6. Inventory Management :- Introduction, Techniques of inventory control with known demand, Economic lot size problem , Problems of EOQ with uniform demand, finite rate of replenishment with shortage etc.
7. Network scheduling by PERT/CPM :- Introduction basic concepts, Activities, Nodes, Network, Critical path time calculations in network, Critical path method (CPM) PERT calculations. Probability of meeting the schedule time.
8. Dynamic Programming :- Introduction, Bellman's optimality criteria. Recursive equation approach for solution of D.P.P. solution of L.P.P. by dynamic programming.

MA451 Operation Research Lab (for IT)

(Sessional Subject)

Full Marks – 50. Contact Periods : 3S

Experiments based on the subject Operation Research (MA403).

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DEPARTMENT OF APPLIED PHYSICS

APPROVED SYLLABUS for UNDERGRADUATE (B.E.) COURSE

PH 1201 PHYSICS (for all Engg. Branches)

SEMESTER EXAMINATION: **CONTRACT PERIODS: (3 L + I T)**
TIME – 3Hrs. **Continious Assessment :**
Full Marks -70 **Full Marks -30**

Fluid Mechanics:
Surface tension & surface energy, pressure difference across a liquid surface rise of liquid in capillary tube.
Streamline and turbulent mation, Reynold's number. Equation of Continuity, Bernoulli's theorem, Toricelli's theorem.
Viscosity, Poiseullie's equation, Capillaries in series andparallel. Terminal velocity and Stokes'Law.

Elastic Properties of Materials:
Relation between elastic constants, internal bending moment, bending of beams cantilever. Torsion of a cylinder, torsional rigidity.

Thermal Physics:
Kinetic theory of gases – Maxwell's velocity distribution law, r.m.s. and most probable velocity.
Transmission of heat – thermal conductivity, conduction of heat through thick pipes, radial flow of heat through spherical shell.
Radiation-emissive and absorptive power, Kirchoff's law, Stefan's law and Wien'slaw.

Optics:
Interference- Superposition of waves, conditions for interference, coherence, fringe width, Fresnel and Fraunhofer diffraction, Fraunholfer diffraction in single slit and double slit, theory of grating, resolving power.
Polarisation – Brewster's law, birefringence, Nocol's prism, production of circularly and elliptically polarized light, half wave and quarter wave plate.

Lasers and Fibre Optics:
Einstein's A & B coefficient, population inversion, He-Ne Laser.
Optical fibre – step and graded index, numerical aperture and acceptance angle.

Electromagnatism:
Gauss' law in electrostatics and its application. Polarisation and Electric displacement. Capacitance of conductors-spherical and cylindrical condensers. Lorentz force, Biot-savart's law,torque on urrent carrying loops, Ampere's circuital law.
Electromagnetic induction – Faraday'slaw, Lenz's law. Concept of displacement current, maxwell's equations. Plane electromagnetic wave equation in one dimension.

Solid State Physics:
Lattice and symmetry, crystal classes. Miller indices. Band theory of solids, Brillouin Zone. Semiconductor, conductivity and mobility, Hall effect. Fermi level, band structure for p-n junction.

Modern Physics:
Relativity- Michelson – Morley experiment. Eintein'sprinciple of relativity. Consequences of special theory of relativity – length contraction, time dilation and concept of mass-energy eqvivalence.
Quantum mechanic – De Broglie's hypothesis, uncertainty principle and its application. Idea of operators in quantum mechanics. Time – dependent and time – independent Schrodinger's equation – application to free particle and particle in a one dimensional box.

Nuclear Physics:
Q value of nuclear reaction, exoergic and endoergic reactions, binding energy and packing fraction. Semi-empirical mass formula. Nuclear fission & fusion basic ideas.

PH 1251 PHYSICS LABORATORY (for all Engg. Branches)

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Full Marks – 50. Contact Periods : (3S)

Laboratory experiments are recommended based on the course **PHYSICS (PH 1201)**

PH 301 MATERIAL SCIENCE (for ME)

Semester Examination : Contact Periods : (3L)

Time-3 hrs. **Internal Assessment :**

Full Marks – 35. **Full Marks – 15.**

Atomic structure and Bonding in solids : Atomic models, vector Model, quantum numbers, Pauli's exclusion principle, interatomic attaractive forces, primary forces of attraction, covalent bonds, ionic bonds, metallic bonds, secondary forces of attraction, molecular polarization, interatomic distances, equilibrium distances, bond lengths.

Crystal Geometry & structure : Space lattice, unit cell, crystal systems, co-ordination number, B.C.C., F.C.C. and H.C.P. structures, lattice planes, Miller indices, interplaner spacing, Bragg's law.

Crystal Imperfection and Metallic phase : Type of Imperfections: Dislocations, Burger vector, mechanism of slip, cold work and recrystallisation.

Electrical and Magnetic Properties of Materials : Classification of solids on the basis of band structure, P and N type semiconductors, ferro-electricity, piezoelectricity, classification of magnetic materials, magnetic hysteresis.

Corrosion : Factors influencing corrosion, Types of corrosion – control and prevention.

Electrical Engineering Materials (PH – 302)

Full Marks – 50 Class : 2L /wk

Atomic Structure: Electrical structure of atoms, Vector atom model [4L]

Crystal Structure: Space lattice, unit cell, crystal systems, co-ordination number and atomic packing fraction, B.C.C. and F.C.C. and H.C.P. structures lattice planes, Miller indices, interplaner spacing, Bragg's law. [6L]

Electrical and Magnetic Properties of Materials: Band structure of solids- Classification on the basis of conductivity, Semiconductors – P and N type semiconductors and their band structures, Fermi level, Ferro-electric and piezoelectric materials,
Dia-, para- and ferro-magnetism, ferro-magnetic domains- hysteresis. Antiferromagnetic and ferromagnetic materials. [15L]

Optical Properties of Materials: LASER – Einstein's A and B coefficients, population inversion, three and four level laser. Basic principles of fiber optics. [5L]

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Engineering Mechanics (AM 101 A)

(For Architecture)

Semester Examination	Contact Period:
Time : 3 hours	**3L + 1T per week**
Examination	**Internal Assessment**
Full Marks: 70	**Full Marks: 30**

Statics:

System of Forces: Free Body Diagram; Condition of Equilibrium; Concurrent and Non-concurrent Forces in a Plane.

Friction: Useful and Harmful Effect of Friction; Laws of Static Friction – Simple Problems on Friction.

Centre of Gravity: Centroids of Simple Geometrical Figures

Concept of Moment of Inertia: Second Moment of Areas; Parallel Axis Theorems.

Dynamics:

D' Alembert's Principle of Moving Bodies; Rectilinear Motion and Curvilinear Motion

Simple Machines:

Laws of Machine; Different Types of Lifting Machines

DR 101 : Engineering Drawing – I

(Common course for CE/ME/Met.E./Min.E./EE/ETC/CST/IT)

Full Marks : 100

Semester Examination — Contact Periods
Time – 3 hrs. — 1L + 0S per week.
Full Marks : 70 — Internal Assessment : Full Marks : 30.

Topics :

Practical Plane Geometry, use of Drawing Instruments, Printing of alphabets in Block Capital, Italics and Mechanical types, Types of lines, dimensioning, use of protractor and scales. Construction of plain, vernier, diagonal and comparative scales.

Method of drawing Geometrical curves as used in engineering practices such as parabola, ellipse, hyperbola, rectangular hyperbola, involute, cycloid, epicycloid, hypo-cycloid, spirals, helix etc.

Practical Solid Geometry, Introduction to orthographic projection, Protection of points, lines, surfaces in 1st and 3rd angle.

Projection of solids and projection of combination of solids in 1st and 3rd angle.
Section of solids and their projections.

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DR 151 : Engineering Drawing Practice – I (Sessional)
(Common course for CE/ME/Met.E./Min.E./EE/ETC/CST/IT)

Full Marks : 100

Contact Hrs.
0L + 6S per week.

Topics :

Lettering and Dimensions, Scales, Curves.

Projection of points, lines and surfaces. Projection of solids and combination of solids.

Projection of section of solids and section of combination of solids.

Engineering Mechanics I (AM 201)
(Common course for CE/ME/Met E/Min E/EE/ETC/CST/IT)

Semester Examination	**Contact Period:**
Time : 3 hours	**3L + 1T per week**
Examination	**Internal Assessment**
Full Marks: 70	**Full Marks: 30**

Force System: Moment of a Force about a point and an axis; Reduction of a force system to a force and a couple.

Equilibrium: Laws Coulomb Friction, Problem Application to wedges, square threaded Screws, Belt friction; Rolling Resistance.

Properties of Areas and Solids: Centroid, Centre of Gravity; Moment of Inertia, Polar moment of Inertia and Principal Axes, Moment of Inertia of rigid Bodies.

Kinetics and Kinematics of Particles: Particle Dynamics in Rectangular Co-ordinates, Cylindrical Co-ordinates and in terms of Path Variables; Central Force Motion; Work and Energy; Impulse and Momentum; Conservation of Energy; Impact; Mechanical Vibration.

Kinetics and Kinematics of Rotation of Rigid Bodies, Resultant Inertia Force in Rotation, Centre of Percussion

Simple Machines

Strength of Materials (AM 201 A)
(For Architecture)

Semester Examination	**Contact Period:**
Time : 3 hours	**3L + 1T per week**
Examination	**Internal Assessment**
Full Marks: 70	**Full Marks: 30**

Introduction; Mechanical Properties of Materials; Simple Stress and Strain; Stress-Strain Diagram; Modulus of Elasticity; Ultimate Stress, Working Stress, Factor of Safety; Stress Concentration; Thermal Stresses; Sample Problems.

Bending of Beams: Types of Beams, Supports and Loads; Bending Stresses in Beams, Shear Force and Bending Moment Diagrams; Sample Problems.

Deflection of Beams: Differential Equations of the Elastic Curve; Relation between Deflection, Slope, Shear Force, Bending Moment etc; Sample Problems.

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Columns and Struts: Definition; Long, Medium and Short Columns; Different Kinds of End Conditions; Safe Load; Euler's Formula for Critical Load; Strength of Columns; Sample Problems

DR 201 : Engineering Drawing – II

(Common course for CE/ME/Met.E./Min.E./EE/ETC/CST/IT)

Full Marks : 75

Semester Examination
Time – 3 hrs.
Full Marks : 50

Contact Periods
1L + 0S per week.
Internal Assessment : Full Marks : 25.

Topics :

Development of Solids. Isometric projections. Temporary and Permanent Fastners, Bolts, Nuts, Rivets and Riveted joints.

Interpenetration of solids. Machine Drawing, Drawing of Simple Machine parts from pictorial views. Machine Drawing Conventions, Dimensioning and Conventional Sectioning. Civil Engineering Drawing.
Introduction to Computer Aided Drawing.

DR 251 : Engineering Drawing Practice – II (Sessional)

(Common course for CE/ME/Met.E./Min.E./EE/ETC/CST/IT)

Full Marks : 75

Contact Hrs.
0L + 3S per week.

Topics :

Developments and Isometric Projections, Projection of Nuts, Bolts and Rivets and Riveted Joints.
Interpretation of Solids, Machine Drawing from pictorial view, Projection of simple machine, Single storied buildings.

CAD :

Introduction to Computer and Software, Operating System and user Interface Introduction to WINDOWS and Introduction to AUTO CAD : (1) Basic 2-D and 3-D commands, (2) Drawing Aids and Text writing, (3) Introduction to Solid Modeling.

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Solid Mechanics I

(For Civil Engineering)

AM 301 **Theoretical Subject**

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Stress, Strain, Elasticity, Hooke's Law, Elastic Constants, Stress-Strain Diagram, Factor of Safety, Working Stress

Thermal Stress, Statically Indeterminate Problems, Strain Energy in Tension, Compression and Shear

Bi-axial Stress, Stresses in Thin –Walled Pressure Vessels, Riveted and Welded Joints

Shearing Force and Bending Moment Diagrams, Relationship between Load, Shearing Force and Bending Moment

Stresses in Beams

Torsion of Circular Shafts

Beams of Two Materials

Mechanical Properties of Materials

Hydraulics I

(For Civil Engineering)

AM 302 **Theoretical Subject**

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Fluid properties: definition of fluid, distinction between solid and fluid, rheological diagram, viscosity, surface tension, compressibility. Units and dimensions.

Fluid pressure: hydrostatic pressure distribution, measurement of pressure by piezometer and different kinds of manometers, relation between absolute and gauge pressures, pressure gauges. Forces on plane and curved immersed surfaces, center of pressure.

Equilibrium of floating bodies : metacentric height and its applications.

Fluid Dynamics: Definitions - steady flow, uniform flow, laminar flow, turbulent flow, one / two / three dimensional flow, streamline, streamtube, streak line, path line. Continuity equation, Euler's equation of motion along a stream line, Bernoulli's energy equation, one dimensional momentum equation and their applications to fluid flow problems.

Flow Measurements : Orifice co-efficients and their relation, external and re-entrant mouthpiece, pitot static tube, derivation of discharge formulae for venturimeter, orificemeter, weirs and notches of different shapes.

Incompressible flow through closed conduits: viscous flow through pipe, critical Reynolds number, derivation and application of Hagen Poiseuille equation. Turbulent flow through pipes, derivation of Darcy-Weisbach equation for head loss, pipe friction laws, minor losses, hydraulic and energy grade lines, pipes in series and parallel.

Dimensional analysis: Dimensional homogeneity of an equation, Rayleigh's method and Buckingham Pi theorem and their application to fluid flow problems. Geometric, kinematic and dynamic similitude, model laws and dimensionless numbers with applications to fluid flow.

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Dynamics of Rigid Bodies

(For Mechanical Engineering)

AM 303 **Theoretical Subject**

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Kinetics of System of Particles: Generalized Newton’s Second Law, Work-Energy, Impulse-Momentum, Conservation of Energy and Momentum

Plane Kinematics of Rigid Bodies: Rotation, Absolute Motion, Relative Velocity, Instantaneous Centre of Zero Velocity, Relative Acceleration, Motion Relative to Rotating Axis

Plane Kinetics of Rigid Bodies : Force, Mass and Acceleration: Fixed Axis Rotation, General Plane Motion; **Work and Energy:** Work-Energy Relations, Acceleration from Work-Energy, Virtual Work; **Impulse and Momentum:** Impulse-Momentum Equations

Three-Dimensional Kinematics of Rigid Bodies:

Translation, Fixed Axis Rotation, Parallel Plane Motion, Rotation about a Fixed Point,

General Motion

Three-Dimensional Kinetics of Rigid Bodies:

Angular Momentum, Kinetic Energy, Momentum and Energy Equations of Motion, Parallel-Plane Motion

Mechanics of Solids I

(For Mechanical Engineering)

AM 304 **Theoretical Subject**

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

General Concept Structures: Type of Loading, Internal Forces, Deformation

Stress, Strain, Elasticity, ’s Law, Elastic Constants, Factor of Safety, Working Stress

Statically Indeterminate Members in Axial Tension and Compression, Thermal Stress

Strain Energy in Member in Axial Tension and Compression

Concept of Bi-Axial Stress, Thin Walled Pressure Vessels

Shearing Stress, Complementary Shearing, Pure Shear, Shearing Strain, Modulus of Rigidity, Poisson’s Ratio, Generalized Hooke’s Law, Relation between E, G and μ

Torsion of Circular Shaft, Power Transmission, Strain Energy in Torsion

Shear Force and Bending Moment in beams, Shear Force and Bending Moment Diagrams

Stresses due to Bending: Bending Stresses, Shearing Stresses, Shear Connectors

Deflection of Simple Statically Determinate Beams, Principle of Superposition

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Mechanical Properties and Testing of Materials

Mechanics of Fluids I

(For Mechanical Engineering)

AM 305 **Theoretical Subject**

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Fluid Properties, Units and Dimensions, Centre of Pressure, Metacentre and Metacentric height, Eulerian and Lagrangian Concepts of description of Motion, Reynolds' Transport Theorem, Integral forms of Continuity, Momentum and Energy Equations, Flow Measurement, Dimensional Analysis and Principle of Similarity, Potential Flow, Laplace Equation, Stream Function, Velocity Potential Function, Flownet, Euler's Equation in Three Dimension, Introduction to Navier-Stokes Equations.

Fluid Mechanics

(For Metallurgy & Mining Engineering)

AM 306 **Theoretical Subject**

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Fluid properties, units and dimensions, pressure at a point, manometers and pressure gauges. Forces on immersed plane and curved surfaces, center of pressure.

Types of flow, definitions, equation of continuity, momentum equation and energy equation and their applications to flow of liquids and gases through closed conduits, forces on nozzles and elbows.

Orifice co-efficients, external and re-entrant mouthpiece, pitot static tube, discharge formulae for venturimeter, orificemeter, wiers and notches of different shapes

Laminar and turbulent flow of liquids and gases through pipes, critical Reynolds number, Hagen Poiseuille equation, pipe friction laws, minor losses, hydraulic and energy grade lines, pipes in series and parallel, hydraulic transmission of power.

Centrifugal and other rotodynamic pumps, classification, application of principle of similarity of hydraulic machines, specific speed of pumps, performance characteristics for head, discharge and efficiency, selection of pumps, reversible pump turbines, hydraulic machines in parallel and series, cavitation and setting height of pumps.

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Strength of Materials and Theory of Machines

(For Electrical Engineering)

AM 307 **Theoretical Subject**

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Strength of Materials

Introduction

Elasticity, Stress, Strain, Hooke's Law, Poisson's Ratio, Stress-Strain Diagram, Working Stress, Proof Stress

Statically Indeterminate problems in Axial Tension and Compression, thermal Stress, Relation Between Elastic Constants

Bi-axial Stresses, Mohr's Circle for Stress

Torsion for Circular Shafts and Power Transmission

General Cases of Plane Stress, Strain Rosette

Bending Moment and Shear Force on Transversely Loaded Beams

Stresses due to Bending and Shear in Beams

Theory of Machines

Flywheel - Turning Moment Diagram, Fluctuation of Energy, Punch Press

Balancing - Dynamics of Rotating Masses, Balancing Technique, Balancing Machine

Governor – Dynamics, Speed Control, Types, Performance Parameter

Vibration - Vibration of Mechanical Systems, Free Vibration, Viscous Damping, Critical Speed, Forced Vibration, Frequency Response, Phase Lag

Dynamics of Rotating Shaft – Effect of Unbalanced Disc, Friction, Gyroscopic Effect, Bearing Stiffness

Solid Mechanics I Laboratory

(For Civil Engineering)

AM 351 **Sessional Subject**

Full Marks – 50. Contact Periods : (3S)

Sessional work based on the course **Solid Mechanics I (AM 301)**

Hydraulics I Laboratory

(For Civil Engineering)

AM 352 **Sessional Subject**

Full Marks – 50. Contact Periods : (3S)

Sessional work based on the course **Hydraulics I (AM 302)**

Mechanics of Solids I Laboratory

(For Mechanical Engineering)

AM 353 **Sessional Subject**

Full Marks – 50. Contact Periods : (2S)

Sessional work based on the course **Mechanics of Solids I (AM 304)**

Mechanics of Fluids I Laboratory

(For Mechanical Engineering)

AM 354 **Sessional Subject**

Full Marks – 50. Contact Periods : (2S)

Sessional work based on the course **Mechanics of Fluids I (AM 305)**

Fluid Mechanics Laboratory

(For Metallurgical and Mining Engineering)

AM 355 **Sessional Subject**

Full Marks – 50. Contact Periods : (3S)

Sessional work based on the course **Fluid Mechanics (AM 306)**

Strength of Materials and Theory of Machines Laboratory

(For Electrical Engineering)

AM 356 **Sessional Subject**

Full Marks – 50. Contact Periods : (3S)

Sessional work based on the course **Strength of Materials and Theory of Machines (AM 307)**

Computer Graphics Practice

(For Mechanical Engineering)

DR 351 **Sessional Subject**

Full Marks – 50. Contact Periods : (2S)

Introduction of Advanced productivity tool for 2D Drawings. Creating 3D solids, Making a solid model from 2D drawing. Alignment of two 3D objects. 2D & 3D Boolean operation.3D & Solid modeling design tips.3D rendering of surfaces. Working with existing Drawings, Raster image & vector image. Storing and linking data with Graphics. Getting and exchanging data from drawings. Introduction to AutoLISP & customization.
Import and export data between different CAD & FE packages.

Solid Mechanics II

(For Civil Engineering)

AM 401 **Theoretical Subject**

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Complex Stresses and Strain in Two Dimension, Strain Rosettes, Applications

Theories of Failure: Graphical Representation

Combined Bending and Torsion with Axial Force

Strain Energy – Importance and Applications, Strain Energy in Bending and Shear, their Uses in Solving Engineering Problems

Theories of Deflection, Method of Differential Equation, Macaulay's Method, Area Moment Theorem, Principle of Superposition, Castigliano's theorem – its Limitations and Applications.

Theory of Columns: Long and Short Columns, Long Columns with Different Boundary Conditions, Long Columns with Eccentric Loading, Rankine's Formula

Unsymmetrical Bending – Expression and Applications

Theory of Beams Curved in Elevation

Shear Centre, Simple Problems

Theory of Vibrations – Simple Applications

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Hydraulics II

(For Civil Engineering)

AM 402 **Theoretical Subject**

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Transmission of hydraulic power through pipeline : condition for maximum power transmission, efficiency of transmission, economics of pipeline.

Analysis of pipe network : Hardy cross method.

Three reservoirs problems.

Open channel hydraulics: distinction between open channel flow and closed conduit flow, classification of flow, geometric elements of a channel section, wide open channel.

Uniform flow : Derivation of Chezy's formula, Mannings formula and their applications to compute normal depth, efficient hydraulic section of different shapes, normal depth in circular channel for maximum velocity and for maximum discharge using both Chezy's and Manning's formulae.

Non-uniform steady flow : specific energy curves, specific force, computation of alternate depths, different criteria for critical flow, computation of critical depth, critical slope and limit slope, flow through channel with hump / contracted section. Derivation of sequent depth relation and head loss for hydraulic jump in rectangular channel, classification of jump, length and height of jump, modular (standing wave) and non-modular flumes.

Hydraulic machines: basic principles, dynamic forces on fixed and moving vanes, torque and power.

Application of principle of similarity of hydraulic machines, specific speed of pumps and turbines.

Turbines : classification and types, power and efficiency, performance characteristics and selection of turbines, draft tube, cavitation and setting height of turbines.

Centrifugal and other rotodynamic pumps : classification, performance characteristics for head, discharge and efficiency, selection of pumps, reversible pump turbines, NPSH & cavitation and setting height of pumps.

Hydraulic machines in parallel and series.

Mechanics of Solids II

(For Mechanical Engineering)

AM 403 **Theoretical Subject**

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Complex Stresses and Strain in Two Dimension, Stresses across inclined Planes, Principal Stresses and Principal Planes, Mohr's Circle for Stress and Strain Rosettes.

Combined Bending and Torsion, Combined Bending, Torsion and Axial Force in Circular Shaft

Theories of Failure: Elastic Theory of Failure, Concept of Ultimate Failure, Factor of Safety and Working Stress.

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Deflection of Beams: Differential Equation of the Elastic Curve, Standard Methods for Determination of Deflection due to Bending for Statically Determinate and Indeterminate Beams, Continuous Beams, Shear Deflection.

Energy Methods: Elastic Strain Analysis in Tension, Compression, Bending, Torsion and Shear, Energy Theorem, Complimentary Energy, Principle of Virtual Work, Theorem of Castigliano and its Application.

Theory of Columns: eccentric Loading on Short Column, Long Column, Euler's Formula for Critical Loads, Empirical Formulae for Long Column, Eccentric Loading on Long Column.

Thick Cylinders, Shrink fit Problems, Disc Rotating at Uniform Speed.

Special problems in Bending: Asymmetrical Bending, Bending in Curved Beams, Hooks and Rings, Shearing Stresses in Thin-Walled Section, Shear Centre.

Limit Analysis

Mechanical Properties of Materials

Mechanics of Fluids II

(For Mechanical Engineering)

AM 404 **Theoretical Subject**

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Navier-Stokes Equations, Exact Solutions, Hydrodynamic Lubrication, Turbulent Flow, Boundary Layer Flow, Boundary Layer Separation, Dynamic Force on Immersed Bodies, Flow through Closed Conduits, Pipe Network, Transmission of Power Through Pipes and Nozzles, External and Internal Compressible Flow, Unsteady Flow though pipe, Water Hammer.

Strength of Materials

(For Metallurgy & Mining Engineering)

AM 405 **Theoretical Subject**

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Stress-strain: Normal and shearing stress, elasticity, Hooke's Law, modulus of elasticity, modulus of rigidity, elastic limit, proportional limit, yield stress, proof stress, ultimate stress, working stress, factor of safety, Poisson's ratio, bulk modulus, concept of thermal stress for both yielding and partially-yielding support conditions, representative problems related to mechanical and thermal stress-strain.

Strain energy: Strain energy for axial loading, resilience, proof resilience, modulus of resilience, simple representative problems.

Bi-axial stress and strain: Introductory concept of bi-axial stress-strain, concept of 2-D Mohr's circle, pure shear, relationship of E, G and μ, analytical and graphical solutions of simple problems related to bi-axial stress-strain.

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Shear force and bending moment: Definitions and mutual relationship, shear force and bending moment diagram of statically determinate beams for all possible types of loading and support conditions.

Theory of bending: Euler-Bernoulli's beam theory with basic assumptions, moment of resistance, section modulus, governing relationship of shear stress in bending, representative problems.

Torsion: Theory of torsion of circular shaft, shear stress in torsion, power transmission, representative problems.

Deflection of beams: Differential equation of deflection of beams, Macaulay's method, moment-area method, statically determinate representative problems.

Columns: Definitions of short and long column, eccentricity and kernel for short column, Euler's critical load for long column for all possible end conditions, concept of eccentric loading in long column.

Theories of failure: Different theories of failure.

Fluid Mechanics and Fluid Machines

(For Electrical Engineering)

AM 406 **Theoretical Subject**

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Fluid properties, units and dimensions, pressure at a point, manometers and pressure gauges. Forces on immersed plane and curved surfaces, center of pressure.

Types of flow, definitions, equation of continuity, momentum equation and energy equation and their applications.

Discharge formulae for venturimeter, orificemeter, wiers and notches of different shapes

Laminar and turbulent flow through pipes, critical Reynolds number, Hagen Poiseuille equation, pipe friction laws, minor losses, hydraulic and energy grade lines, pipes in series and parallel, hydraulic transmission of power.

Turbines, classification and types, power and efficiency, performance characteristics and selection of turbines, draft tube, cavitation and setting height of turbines.

Application of principle of similarity of hydraulic machines, specific speed of pumps and turbines

Centrifugal and other rotodynamic pumps, classification, performance characteristics for head, discharge and efficiency, selection of pumps, reversible pump turbines, hydraulic machines in parallel and series.

Working principles of accumulator, intensifier, fluid coupling, torque converter, gear pump, vane pump, piston pump, and control valves.

Solid Mechanics II Laboratory

(For Civil Engineering)

AM 451 **Sessional Subject**

Full Marks – 50. Contact Periods : (3S)

Sessional work based on the course **Solid Mechanics II (AM 401)**

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Hydraulics II Laboratory

(For Civil Engineering)

AM 452 **Sessional Subject**

Full Marks – 50. Contact Periods : (3S)

Sessional work based on the course **Hydraulics II (AM 402)**

Mechanics of Solids II Laboratory

(For Mechanical Engineering)

AM 453 **Sessional Subject**

Full Marks – 50. Contact Periods : (2S)

Sessional work based on the course **Mechanics of Solids II (AM 403)**

Mechanics of Fluids II Laboratory

(For Mechanical Engineering)

AM 454 **Sessional Subject**

Full Marks – 50. Contact Periods : (2S)

Sessional work based on the course **Mechanics of Fluids II (AM 404)**

Strength of Materials Laboratory

(For Metallurgical and Mining Engineering)

AM 455 **Sessional Subject**

Full Marks – 50. Contact Periods : (3S)

Sessional work based on the course **Strength of Materials (AM 405)**

Fluid Mechanics Laboratory

(For Electrical Engineering)

AM 456 **Sessional Subject**

Full Marks – 50. Contact Periods : (3S)

Sessional work based on the course **Fluid Mechanics (AM 406)**

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Machine Drawing

(For Mechanical Engineering)

DR 451 **Sessional Subject**

Full Marks – 50. Contact Periods : (3S)

Different sectional views of the Machine parts.
Keys, Splines, Couplings and Valves
Bearing – Sliding and Rolling contact Types, Brackets and Pulleys
Cotter and Knuckle Joints
Assembly Drawing
Springs – Helical and Laminated

Dynamics of Machines and Vibration

(For Mechanical Engineering)

AM 601 **Theoretical Subject**

Semester Examination : Contact Periods : (3L+ 0T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 70. **Full Marks – 30.**

Flywheel - Dynamic Force and Motion Analysis of Plane Mechanism – Turning Moment Diagram and Flywheel, Fluctuation of Energy, Fluctuation of Speed, Power Smoothening of a Punch Press by Flywheels, Dynamically Equivalent System

Gyroscopes – Gyroscopic Forces and Couples, Gyroscopic Effects in Machines, Stability of a Four Wheel and Two Wheel

Drive Vehicle.

Balancing - Dynamics of Rotating Bodies, Unbalance Effects and Balancing of Inertia Forces, Field Balancing and Balancing Machines.
Dynamics of Reciprocating Machines with Single Slider; Unbalance in Single Cylinder Engine Mechanisms, Unbalance in Multi Cylinder Engines -In-line, V-twin and Radial Engines; Tractive Force, Swaying Couple, Hammer Blow, Coupled and Uncoupled Locomotive, Balancing Techniques.

Governor - Speed Control By Governors, Dynamics of Governor Mechanisms, Different Types of Governors, Performance Parameter, Governor Effort and Power, Control Force.

Vibration - Vibration of Mechanical Systems, Types of Vibration, Lumped Parameter Models, Linearization of System Elements, Degrees of Freedom, Types of Restoration and Dissipation Mechanisms; Types of Excitation.

Free Undamped Vibration of Single Degree of Freedom Systems, Determination of Natural Frequency, Equivalent Inertia and Stiffness, Energy Method, Phase Plane Representation.
Free Vibration with viscous Damping, Critical Damping and Aperiodic Motion, Logarithmic Decrement, Systems with Coulomb Damping.

Forced Vibration with Harmonic Excitation, Undamped Systems and Resonance, Viscously Damped Systems, Frequency Response Characteristics and Phase Lag, Systems with Base Excitation, Transmissibility and Vibration Isolation, Whirling of Shafts and Critical Speed.

Vibration of Two and Multidegrees of Freedom Systems; Concept of Normal Mode, Free Vibration Problems and Determination of Natural Frequencies, Forced Vibration Analysis, Vibration Absorbers, Approximate Methods -Dunkerley's Method and Holzer Method.

Free Vibration of Elastic Bodies, Longitudinal Vibration of Bars, Transverse Vibration of Beams, Torsional Vibration of Shaft, Approximate Methods - Rayleigh's Method and Rayleigh-Ritz Method.

Dynamics of Rotating Shaft – Effect of Unbalanced Disc, Friction, Gyroscopic Effect, Bearing Stiffness, Oil Film, Whirling of Shafts with Distributed Mass.

Instruments for Dynamic Measurements

Fluid Power Engineering (AM 701)

(For Mechanical Engineering Branch)

Semester Examination	**Contact Period:**
Time: 3 hours	**3L + 0T per week**
Examination	**Internal Assessment**
Full Marks: 70	**Full Marks: 30**

Similarity Analysis of Rotodynamic Machines; Shape Number, Specific Speed and Classification; Euler's Equation for Turbomachines; Impulse and Reaction Turbines; Penstock, Surge Tank, Draft Tube, Governors etc.; Turbine Characteristics; Centrifugal, Axial and Mixed Flow Pump Analysis; Pump Characteristics; Cavitation and NPSH; Pump Design;

Special Purpose Machine – Jet Propulsion Device; Fluid Coupling, Torque Convertor;

Positive Displacement Pumps and Motors (Gear, Vane and Piston Type); Performance Characteristics and Optimisation; Hydraulic Actuator; Control Valves and Accessories; Basic Hydraulic Circuits.

AM 801 : FINITE ELEMENT METHOD

(For C.E./ M.E./ Met.E.)

Semester Examination	Contact Periods :
Time : 3 hours	3L + 1T + 2* per week
Full Marks : 70	Internal Assessment :
	Full Marks : 30

(*Two hours sessional for C.E. branch only)

Introduction, scope of the method, examples highlighting applications.

Matrix algebra relevant to FEM, solution of large system of simultaneous equations.

Basic concepts of discretization, variational principle.

Plane stress, plane strain and axisymmetric problems, general formulation for stress analysis problems.

Displacement formulation, stiffness and load matrices, assembly, local and global system – transformation, substitution of boundary conditions and solution of equations.

Stress determination, choice of elements, initial and thermal stress problems.
Computer programming and demonstration problems.

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AM 802 : ADVANCED STRENGTH OF MATERIALS
(For C.E./ M.E.)

Semester Examination
Time : 3 hours
Full Marks : 70

Contact Periods :
3L + 1T + 2* per week
Internal Assessment :
Full Marks : 30

(*Two hours sessional for C.E. branch only)

State of stress at a point under three-dimensional stress system, stresses on a plane of general position : Mohr's theory of limiting state of stress.

Bending and torsion of thin walled bars, shear centre, warping of sections.

Curved beams, beams curved in plan.

Principles of design beyond the elastic limit, elastoplastic bending of a bar.

Fatigue, stress concentration, effect of surface finish, factor of safety.

Fundamentals of elasticity, stress in thick walled circular cylinders and spheres, stresses in rotating disc and cylinders.

Stability of deformable systems, beam column, torsional buckling, lateral buckling – simple cases.

Energy theorems, reciprocal theorems, principle of virtual work, application of energy principles.

Springs – closed and open coiled helical springs, leaf, flat and spiral springs.

Impact stresses in rods.

Experimental methods : measurement of strain, elementary concept of photo elasticity, electrical analogy and Moire fringe technique.

Numerical methods – Finite difference technique, relaxation, Introduction to finite element analysis.

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AM 803 : GROUND WATER FLOW

(For C.E.)

Semester Examination
Time : 3 hours
Full Marks : 70

Contact Periods :
3L + 1T + 2* per week
Internal Assessment :
Full Marks : 30

(*Two hours sessional per week)

Fundamentals of Ground Water Flow : Nature of soil body, Porosity, Specific yield and Specific retention. Darcy's law and its validity, permeability, capillarity, transmissivity.

General Hydrodynamic Equations : Velocity Potential and Stream Functions, Flow net, Boundary conditions, Seepage Force and Critical gradient, Anisotropy.

Confined flow problems : Fully and partially penetrating wells, Hydraulic structures on permeable media.

Dupuit's theory and its application to unconfined flow problems, Seepage through earth dams, Radial flow into completely penetrating wells.

Ground Water Exploration : Remote sensing, Surface Geophysical Methods, Well logging, Pumping tests, Design of wells, Methods of construction of wells.

Methods of solution of Ground water flow problems : Analytical, Numerical, Graphical, Experimental, Electrical, viscous and other analogy methods.

AM 804 : FLOW THROUGH POROUS MEDIA

(For C.E./ M.E.)

Semester Examination
Time : 3 hours
Full Marks : 70

Contact Periods :
3L + 1T + 0* per week
Internal Assessment :
Full Marks : 30

Properties of porous media, laws of seepage, laboratory and field determination of permeability.

General Hydrodynamic Equations, Velocity Potential and Stream functions, Flow net, Boundary conditions. Graphical, Numerical and experimental analog methods of solutions.

Elements of conformal transformations, Schwarz-Christoffel transformation, Free streamline theory.

Dupuit's theory and its application to unconfined flow problems, Steady and unsteady Radial flow into completely penetrating wells.

Elements of flow of two or more immiscible fluids.

Sub surface explorations, Design and Construction of wells.

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AM 805 : WATER PPOWER ENGINEERING

(For C.E./ M.E./ E.E.)

Semester Examination
Time : 3 hours
Full Marks : 70

Contact Periods :
3L + 1T + 2* per week
Internal Assessment :
Full Marks : 30

(*Two hours sessional for C.E. branch only)

Hydrology – hydrologic cycle, precipitation, water losses, infiltration, run-off, hydrograph.

Planning and operation of Hydropower plants – peaking and base load. Integration of several types of power plants. Estimates of water power, flow duration curve, mass curve, storage and pondage, pumped storage, economics.

Location of Hydro-electric station – investigation of site, number and types of dam, spillways, canals, fore bay, intake, penstock. Water hammer and surge tank.

Power House Equipment – choice of turbine, synchronous speed, size of generator, governors, flow meters, transformer, crane, office etc. space, switch yard.

Types of Hydro power stations, powerhouse sub-structure, super-structure, architecture.

Special features of low head turbines and reversible pump turbines.

AM 806 : FLUID SYSTEM AND CONTROL

(For M.E.)

Semester Examination
Time : 3 hours
Full Marks : 70

Contact Periods :
3L + 1T + 0 per week
Internal Assessment :
Full Marks : 30

Introduction to feedback control; Transfer Function; Steady-State and Transient Response behaviour; Frequency Response Analysis; State-Space Method; Stability;

Rotary Pumps and Motors; Hydraulic Actuator; Control Valves; Steady-State Analysis; Linearisation and Valve Null Characteristics (Flow Gain, Pressure Sensitivity etc.); Accumulator and Intensifier;

Pump Controlled Motor; Valve Controlled Motor; Analysis and Design of Simple Hydraulic Circuits; Hydraulic Controllers (Proportional, Integral, PI, PID etc.); Hydraulic Relay; Electrohydraulic Servovalve and Servomechanism; Logic Circuits; Industrial Applications;

AM 807 : EXPERIMENTAL ANALYSIS OF STRESS AND STRAIN

(For C.E./ M.E./ Met.E.)

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Semester Examination | Contact Periods :
Time : 3 hours | 3L + 1T + 2* per week
Full Marks : 70 | Internal Assessment :
Full Marks : 30

Analysis and measurement of strain, determination of stresses from strain, strain rosette.

Strain gauges : Mechanical gauges and extensometers, optical methods of strain measurement, electrical resistance gauges, circuit theory, measurement of static and dynamic strains, inductance and capacitance gauges.

Photo-elasticity : Elementary concepts – polarization, the photo-elastic effect, fundamental laws of photo-elasticity; The polariscope, interpretation of photo-elastic stress pattern.

Compensation techniques, fringe sharpening and fringe multiplication devices, separation of principal stresses, photo-elastic model materials, application to two-dimensional problems.

Introduction to brittle coating technique, photo-stress coating technique and Moire' fringe technique.

AM 808 : ADVANCED SOLID MECHANICS

(For Met.E.)

Semester Examination | Contact Periods :
Time : 3 hours | 3L + 1T + 0 per week
Full Marks : 70 | Internal Assessment :
Full Marks : 30

(To be given in consultation with the Met.E. Deptt.)

AM 809 : OIL HYDRAULIC SYSTEM AND CONTROL

(For Min.E.)

Semester Examination | Contact Periods :
Time : 3 hours | 3L + 1T + 0 per week
Full Marks : 70 | Internal Assessment :
Full Marks : 30

Introduction, definitions, JIC symbols, hydraulic fluids.

Hydraulic cylinder and high pressure rotary pumps and motor – Gear vane and piston type – General classification, operating, working principle and application.

Simple control control valves – Pressure, flow and direction control – Valve construction, working principle and application, servo valve and servo mechanism.

Accumulator, pipes, tubes, hose and fittings and oil seats.

Simple and compound hydraulic circuits.

Application of high pressure hydraulics in Mining Equipment.

AM 810 : FINITE ELEMENT TECHNIQUE

(For Min.E.)

Semester Examination | Contact Periods :

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Time : 3 hours 3L + 1T + 0 per week
Full Marks : 70 Internal Assessment :
Full Marks : 30

Introduction, scope of the method, examples highlighting applications.

Basic concepts of discretization, Matrix algebra relevant to FEM, solution of large system of simultaneous equations.

General formulation for stress analysis problems, variational principle.

Plane stress, plane strain and axisymmetric problems.

Displacement formulation, stiffness and load matrices, assembly, local and global system – transformation, substitution of boundary conditions.

Determination of stress, choice of elements, initial stress and thermal stress.

Computer programming.

AM 811 : ADVANCED FLUID MECHANICS

(For Min.E.)

Semester Examination Contact Periods :
Time : 3 hours 3L + 1T + 0 per week
Full Marks : 70 Internal Assessment :
Full Marks : 30

Hydrodynamics : Three dimensional continuity equation, Stream function, Fluid rotation, Velocity potential function, flow net, Euler's equations, Bernoulli's theorem.

Statement of Navier Stokes equations with a few exact and approximate solutions.

Properties of porous media, laws of seepage, laboratory and field determination of permeability.

Graphical, Numerical and experimental analog methods of solutions.

One Dimensional Compressible Fluid Flow : Energy equation, celerity of pressure wave, stagnation point, flow through variable section, critical pressure ratio, compression shock.

Compressible flow with friction and heat transfer : Isothermal flow in pipe with friction, flow of gas in insulated pipes, friction less flow in pipes with heat transfer.

General features of dynamic machines : Surging in fan and compressor system, basic equations, similarity relations, specific speed, cavitation.

Axial flow fans, pumps and compressors.

Centrifugal fans, pumps and compressors.

AM 812 : HUMAN BODY MECHANICS

(For C.E./ M.E.)

Semester Examination Contact Periods :
Time : 3 hours 3L + 1T + 2* per week
Full Marks : 70 Internal Assessment :

Full Marks : 30
(Two hours sessional for C.E. branch only)

Elements of physiology and anatomy of the human body, body system involved in human movement – muscular system, skeleton action – neural control of movement – muscular contractile mechanism – strength, endurance, muscular power, speed of contraction, muscle tone.

Application of mechanical laws and principles – Application of statics to biomechanics – Determination of forces on the head of femur and hip abductor muscles, forces on lumber Vertebrae using bending and lifting, condition of fracture of tibia during fall – levers & other simple machines – Determination of centre of gravity of body segments – different posture – Kinematic and Kinetic analysis of human motion – Visco-elasticity & biological tissues – spring and dash pots system – Cardiac mechanism & circulatory system.

NOTE : Pre-requisite : Students of different discipline having Engineering Mechanics (Statics and Dynamics) and Strength of Materials in earlier semesters are eligible to take the subject as elective.

AM 813 : MODERN COMPRESSIBLE FLOW

(For M.E.)

Semester Examination
Time : 3 hours
Full Marks : 70

Contact Periods :
3L + 1T + 2* per week
Internal Assessment :
Full Marks : 30

One-Dimensional Flow: Introduction, Hugoniot Equation, Flow with Heat Transfer, Flow with friction.

Two-Dimensional Flow: Introduction, Reflection of Shock Waves from Solid Boundary, Shock Polar, Pressure-Deflection Diagrams, Prandtl-Meyer Expansion Waves, Shock-Expansion Theory.

Quasi-One-Dimensional Flow: Introduction, Isentropic Flow of a Callorifically Perfect Gas through Variable-Area Duct, Wave Reflection from a Free Boundary.

Unsteady Wave Motion: Introduction, Moving normal shock Waves, Reflected Shock Wave, Elements of Acoustic Theory, Finite (Nonlinear) Waves, Incident and Reflected Expansion waves, Shock Tube Relations, Finite Compression Waves.

General Conservation Equations: Introduction, Differential Equations, Entropy Equation, Crocco's Theorem, Irrotational Flow, The Velocity Potential Equation.

Linearised Flow: Introduction, Linearised Velocity Potential Equation, Linearised Pressure Coefficient, Linearised Subsonic Flow, Compressibility Correction, Linearised Super-Sonic Flow, Critical Mach Number.

AM 814 : POTENTIAL METHODS IN FLUID FLOW

(For M.E.)

Semester Examination
Time : 3 hours
Full Marks : 70

Contact Periods :
3L + 1T + 2* per week
Internal Assessment :

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Full Marks : 30

Inviscid Incompressible Flow: Introduction, Governing Equation for Irrotational Incompressible Flow – Laplace's Equation, Elementry Flows, Superpositions of Irrotational Flows, Nonlifting Flow over Arbitrary Bodies: The Numerical Source Panel Methods.

Ideal Fluid Flow over Airfoils: Introduction and Philosophy of Theoretical Solution for Low Speed Flow over airfoils, Kutta Condition, Airfoil Nomencleture and Characteristics, Classical Thin Airfoil Theory, Lifting Flows over Arbitrary Bodies: The Numerical Vortex Panel Methods.

Ideal Fluid Flow over Finite Wings: Introduction – Downwash, Induced Drag, The Vortex Filament, Prandtl's Classical Lifting Line Theory, Numerical Nonlinear Lifting Line Method, The Lifting Surface Theory and The Vortex Lattice Numerical Method

Inviscid Compressible Flow: Introduction, Governing Equations, Entropy Equation, Crocco's Theorem, The Velocity Potential Equation.

Linearised Flow: Introduction, Linearised Velocity Potential Equation, Linearised Pressure Coefficient, Linearised Subsonic Flow, Compressibility Correction, Critical Mach Number, Linearised Super-Sonic Flow.

AM 815 : FINITE ELEMENT METHOD SESSIONAL

(For C.E. only)

Full Marks : 50 Contact Periods : 2S per week

Sessional works based on the Course : AM 801 – Finite Element Method.

AM 816 : ADVANCED STRENGTH OF MATERIALS SESSIONAL

(For C.E. only)

Full Marks : 50 Contact Periods : 2S per week

Sessional works based on the Course : AM 802 – Advanced Strength of Materials.

AM 817 : GROUND WATER FLOW SESSIONAL

(For C.E. only)

Full Marks : 50 Contact Periods : 2S per week

Sessional works based on the Course : AM 803 – Ground Water Flow.

AM 818: WATER POWER ENGINEERING SESSIONAL

(For C.E. only)

Full Marks : 50 Contact Periods : 2S per week

Sessional works based on the Course : AM 805 – Water Power Engineering.

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AM 819 : EXPERIMENTAL ANALYSIS OF STRESS AND STRAIN SESSIONAL

(For C.E. only)

Full Marks : 50 Contact Periods : 2S per week

Sessional works based on the Course : AM 807 – Experimental Analysis of Stress and Strain.

AM 820 : HUMAN BODY MECHANICS SESSIONAL

(For C.E. only)

Full Marks : 50 Contact Periods : 2S per week

Sessional works based on the Course : AM 812 – Human Body Mechanics.

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DEPARTMENT OF ARCHITECTURE AND TOWN AND REGIONAL PLANNING

DEPARTMENT OF ARCHITECTURE AND TRP

APPROVED SYLLABUS for UNDERGRADUATE (B.E.) COURSE

1st & 2nd semester B.Arch. Courses

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HU 101 **E N G L I S H F O R E N G I N E E R S**

Semester Examination: **Contact Periods: (2L)**
Time – 2hrs. **Internal Assessment:**
Full Marks – 35 **Full marks – 15**

Group-A

Note Making
Paragraph writing
Commercial Correspondence
Précis
Preparing Instruction Manual
Preparing Proposal
Report Writing
Writing of Dissertation/Thesis
Elements of Grammar and Vocabulary

Group-B

Group Discussion
Extempore Speaking
Presentation Strategies
Interview Preparation

This course seeks to develop a sense of language through texts drawn from contemporary writings in newspapers, newsmagazines, reports etc.

MA 102 A **M A T H E M A T I C S – I A**

Semester Examination: **Contact Periods: (2L + 1T)**
Time – 3hrs. **Internal Assessment:**
Full Marks – 70 **Full marks – 30**

A. Differential Calculus:
Successive differentiation, Rolle's Theorem (Statement only), MVT, Geographical interpretations, Taylor's Theorem with Cauchy's and Lagrange's Form of reminders, Taylor's and Maclaurin's series, Expansion of function.

B) Application of Differential Calculus:
Angle of intersection of curves, Curvature, Asymptotes, Envelopes.

C) Convergence of Infinite Series:
Simple idea relating to sequence, convergency and divergency of infinite series. Tests of convergence.

D) Matrices and Determinants:
Definition, Sum and product of matrices, Transpose, Symmetric and Skew symmetric matrix, Determinant of square matrices and their simple properties, Inverse of matrices, Rank of matrices,

Solutions of system of linear equations: Cramer's Rule, Matrix method, Consistency and Inconsistency (only cases of m×n matrix with m, n≤4).

AM 101A **ENGINEERING MECHANICS**

Semester Examination: **Contact Periods: (3L + 1T)**
Time – 3 hrs. **Internal Assessment:**
Full Marks – 70 **Full marks – 30**

Semester Examination: **Contact Periods: (3L + 1T)**
Time – 3 hrs. **Internal Assessment:**
Full Marks – 70 **Full marks – 30**

GROUP - A

Module 1 INTRODUCTION

Concept of Engineering Mechanics – Statics & Dynamics – Scalar Quality – Vector Quality – Addition & Subtraction of Vectors – Basic units – Derived Units – SI units – Relationship: M.L.T.

Module 2 SYSTEM OF FORCES

Definition of a force with explanation – Linear representation of force – System of co-planar forces – Parallelogram Law of Forces – Composition and Resolution – Transmissibility of forces – Action and Reaction – Triangle Law & Polygon Law of forces – Determination of Resultant by Analytical and graphical method with equalitarian space diagram – Vector diagram – Bow's notation.

Module 3 MOMENTS & COUPLES

Definition of moment of a force about a point – Physical significance of moment – Moment of a system of parallel and inclined forces – Varignon's Theorem – Definition of moment of a couple – Physical significance of Couples Equivalent couples – Resultant of any number of coplanar couples – Replacement of a force about a point by an equal like parallel force together with a couple – Resultant of a couple and a force.

Module 4 CONDITION OF EQUILIBRIUM

Lami's Theorem – Triangle Law & Polygon Law of equilibrium – Conditions of equilibrium of co-planer system of concurrent forces – Conditions of equilibrium of co-planar system of non-concurrent parallel forces (like & unlike) – Conditions of equilibrium of co-planar system of non-concurrent non-parallel forces (simple problems excluding statically indeterminant)

GROUP - B

Module 5 FRICTION

Definition – Useful and harmful effects of friction – Laws of Static friction – Co-efficient of friction – Angle of friction – Angle of repose – Equilibrium of a body on a rough inclined surface with and without external force.

Module 6 CENTRE OF GRAVITY

6.1 Concept & definition – Centre of mass – Centroid
6.2 Methods of finding out centroids of simple area
6.3 Finding the centroid of the following areas by integration**:** (i) uniform triangular lamina, (ii) uniform rectangular lamina, (iii) uniform circular lamina, (iv) uniform semi-circular lamina, and, (v) uniform lamina of quadrant of a circle.
6.4 Finding the centriod of the following sections using the method of moment**:** (i) T-section, (ii) equal and unequal angle-sections, (iii) equal and unequal I-sections, (iv) Channel-sections, (v) Z-sections.

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Module 7 MOMENT OF INERTIA

7.1 Introduction – definition and unit
7.2 M I of a lamina
7.3 Theorems of finding out M I by: (i) Parallel axis theorem, and, (ii) Perpendicular axis theorem.
7.4 Radius of Gyration
7.5 Finding out M I of the different sections about axes lying in the plane of the sections by integration
7.6 M I of irregular areas such as I-sections, T-sections, Angle-sections, Channel sections, Z-section, Composite sections (composite area method) – Related simple problems.
7.7 Polar M I

G R O U P - C

Module 8 RECTILINEAR MOTION

Displacement-Time and Velocity-Time diagrams – Motion equations (with deduction) – Newton's Second Law of linear motion p = mf and momentum of a body – Conservation of momentum of a body – Numerical problems.

Module 9 CURVILINEAR MOTION

Angular displacement – Angular speed – Angular velocity – Relation between angular speed & angular velocity – Angular acceleration – Relation between linear & angular velocity – Relation between linear & angular acceleration – Motion and path of a projectile (numerical problems) – Centripetal and centrifugal force (numerical problems)

AR 101 D E S I G N F U N D A M E N T A L S

Semester Examination:	**Contact Periods: (3L)**
Time – 3 hrs.	**Internal Assessment:**
Full Marks – 70	**Full marks – 30**

Module 1 Introduction to Design

Defining design — Design as a process — Thought process as a design process: Vertical & Lateral

Module 2 Contrast

2.1 PERCEPTION OF LIGHT: Chrome – Brightness – Hue – Saturation
2.2 PERCEPTION OF REFLECTING SURFACES: Tonal quality: value, hue & intensity – Visual texture
2.3 COMPOSITION – FIGURE-GROUND RELATIONSHIP: Space, Shape, Format, Figure, Ground, Closure

Module 3 FIGURE ORGANISATION

3.1 SPATIAL BASIS FOR GROUPING OF FIGURE ELEMENTS: SHAPES THAT TOUCH: Corner to corner – Corner to side – Side to side — SHAPES THAT OVERLAP: Partially – Completely — SHAPES THAT INTERCONNECT: Interpenetrating – Interlocking – Interlacing
3.2 LIKENESS BASIS FOR GROUPING OF FIGURE ELEMENTS: FORMAL FACTORS: Shape – Size – Position (direction, interval, attitude) — TONAL FACTORS: Achromatic-chromatic – Warm-cool – Value – Hue – Intensity — VISUAL TEXTURE — MEANINGS FROM EXPERIENCE: Representation – Association – Symbolism
3.3 VARIETY IN UNITY: HOGARTH'S "LINE OF BEAUTY"

Module 4 THE IDEA OF UNITY

4.1 QUALITIES OF UNITY: Pattern of Movement – Balance – Proportional Relationships – Rhythm — BACKGROUND OF VISUAL UNITY: Structure of Visual Field – Eye movements in perception
4.2 MOVEMENT & BALANCE: MOVEMENT IN DESIGN – Dynamic Values in the Field — BALANCE: Axial Balance – Radial Balance – Occult Balance

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4.3 PROPORTION & RHYTHM: Analyzing proportion & rhythm: Simple numerical ratios – Values of the summation series – Geometric Ratios – Dynamic symmetry (golden-mean rectangle, root-five rectangle, root-two rectangle) & Intrinsic geometric ratios — RHYTHM: Sequence of Progression & Alteration – Occult Rhythm — DOMINANCE & SUB-ORDINATION

Module 5 COLOUR: PIGMENT & TONE CONTROL

5.1 COLOUR THEORY: Subtractive mixing

5.2 COLOUR WHEEL: Primaries – Secondaries – Tertiaries

5.3 TONE CONTROL: T = H + B + W – Tints [T = H + W] – Shades [T = H + B] – Greyed tones [T = H + (B + W)] – Complimentary (T = H + cH)

5.4 **COLOUR RELATIONSHIPS**

6.1 COLOUR SCHEMES: RELATED (Monochromatic & Analogous) – CONTRASTING (Complementary, Split Complimentary & Triad)

6.2 PHYSIOLOGICAL-PSYCHOLOGICAL BASIS FOR COLOUR RELATIONS: Likeness – Sequence in hue, value and intensity perception – Psychological complements

6.3 SIMULTANEOUS CONTRAST: Value Contrast – Hue Contrast – Intensity Contrast

Module 6 DEPTH & PLASTIC ILLUSION: 2-D ORGANISATION

7.1 BASIS OF SPACE ILLUSION

7.2 INDICATION OF DEPTH ON A TWO-DIMENSIONAL PLANE: Contrast & gradation in size – Converging parallels & diagonal action – Position in the picture plane – Overlapping – Transparency – Diminishing detail – Atmospheric perspective – Advancing & receding colour

7.3 PLASTIC EFFECT ON TWO-DIMENSIONAL PLANE: Structural Enhancement, line – Differences of tone – Charoscuro Modelling – Effect of light

Module 7 DEPTH & PLASTIC ILLUSION: 3-D ORGANISATION

8.1 Plastic Elements of Patterning Space: Solids – Planes – Lines – Space — Closed and Open Form

8.2 PLASTIC MOVEMENTS: Linear elements – Axial elements – Compositional Elements — Plastic Balance – Proportion & Rhythm

8.3 INTER-RELATIONSHIP BETWEEN MATERIAL, STRUCTURE & FORM: Homogeneous materials – Assembled materials

Module 8 Design Methodology

General principles of architectural design on the basis of functions and forms **— B**rief – **A**nalysis – **S**ynthesis – **I**mplementation – **C**ommunication & Feedback — Journey from known to unknown

REFERENCE BOOKS

1. Design Fundamentals / Robert Scott
2. Form, Space and Order / F.D.K. Ching
3. Introduction to Architecture / J. C. Snyder & A. J. Catanese
4. Space, time and Architecture / Gidieon"

AR 102 MATERIALS & METHODS OF CONSTRUCTION–II

Semester Examination:	**Contact Periods: (3L)**
Time – 3 hrs.	**Internal Assessment:**
Full Marks – 70	**Full marks – 30**

Module 1 Stone Masonry

1.1 Classification of Rocks: Igneous, Sedimentary, Metamorphic (Definitions with examples)

1.2 Technical terms associated with stone masonry

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1.3 Characteristics of good building stone
1.4 General principles to be followed in stone masonry
1.5 Types of stone masonry: (i) Rubble work, (ii) Ashlars (Concepts only)

Module 2 Clay Products – Brick Masonry

2.1 Composition of Good Brick Earth
2.2 Manufacturing Process of Brick (in brief) – Sizes of bricks
2.3 Classification of Bricks – Strength of different Grades of Brick
2.4 Technical terms associated with brickwork
2.5 General Principles in Brick Masonry Construction
2.6 Bonds in brickwork: English, Flemish and CBRI

Module 3 Other Clay Products

3.1 Ceramic – Earthenware – Terracotta – Porcelain – Stoneware
3.2 Clay tiles: Flat tiles – Pan tiles – Half-round country tiles – Mangalore tiles

Module 4 Wood & Wooden Products

4.1 CLASSIFICATION OF TREES: Exogenous & Endogenous — Structure of timber — Classification of timber: Hardwood, Softwood
4.2 PROCESSING OF TREE TO TIMBER: Felling – Seasoning – Preservation – Conversion (concept only)
4.3 DEFECTS IN TIMBER: Natural defects, Conversion defects, Seasoning defects — Characteristics or Specification of timber
4.4 WOODEN PRODUCTS: Veneer – Plywood – Laminated board – Block board – Batten board – Composite boards – Fibreboard – Particleboard (properties and uses)
4.5 ADHESIVES: Selection of adhesives – Classification of adhesives: Organic & Synthetic.

Module 5 Ferrous Metals – Iron & Steel

5.1 General characteristics of metals: Ductility – Elasticity – Malleability – Toughness - Weldability
5.2 Properties & uses of Iron Ores – Pig Iron – Cast Iron – Wrought Iron – Mid Steel (plain carbon steel)
5.3 Properties & uses of different modern alloy steel (hard steel)

Module 6 Non-ferrous Metals – Aluminium & Copper

6.1 ALUMINIUM: Properties – Finishes (anodising, plastic coatings, paint) – Different uses of Aluminium
6.2 COPPER ALLOYS: Properties and uses of Brass & Bronze

Module 7 Plastics

7.1 Polymerisation – Polymer types: Thermoplastics, Thermosetting plastics, Elastomers
7.2 Properties of plastics: Strength – Thermal & moisture movement – Environment
7.3 Plastics in construction: (a) Thermoplastics: Polythene (polyethylene) – Polyvinyl chloride – Nylons; (b) Thermosetting plastics: Phenol formaldehyde – Urea formaldehyde, (c) Elastomers: Natural rubber – Neoprene – Polypropylene (properties & uses)

Module 8 Glass

8.1 Principal constituents of glass
8.2 Manufacture of glass: Batching of raw materials, melting, fabrication, finishing and annealing (concept only)
8.3 Glass products in construction: Sheet Glass – Plate Glass – Glass Pipes – Glass Blocks – Glass wool – Foam glass (properties & uses)
8.4 Special and industrial use of glass: Obscured Glass – Bulletproof Glass – Wired glass – Safety Glass –Laminated Glass (properties & uses)

REFERENCE BOOKS

1. Materials for Architects and Builders: An Introduction / Arthur R Lyons / Arnold

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2. A Text Book of Materials and Construction / TTTI
3. Building Construction Volume I, II, III & IV (Metric Ed.) / J. K. McKay & W. B. McKay / Orient Longman
4. The Construction of Buildings Volume 1, 2, 3, 4 & 5 / R. Barry / English Language Book Society
5. A Text Book of Building Construction: Planning Techniques & Methods of Construction / S. P. Aurora & S. P. Bindra /
6. Building Construction / Sushil Kumar / Standards Publishers Distributors, Delhi

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AR 103 **D E S C R I P T I V E G E O M E T R Y**

Semester Examination:	**Contact Periods: (1L)**
Time – 3 hrs.	**Internal Assessment:**
Full Marks – 35	**Full marks – 15**

Module 1 A) Introduction to Engineering Drawing and Descriptive Geometry – Language of Engineers and Architects.

B) Introduction to the drawing instruments and their use.

Module 2 Various types of lines used in Engineering Drawing – Lettering techniques and types.

Module 3 Scale – Concept of representative fraction – Scale generally used for Architectural and Engineering Drawing – Concept of diagonal scale.

Module 4 Orthographic Projections – Planes of Projection – Concept of 1^{st} angle and 3^{rd} angle projection – ISI code of practice – projection of straight line, lamina and solid.

Module 5 Section of Solids – True shape of a section.

Module 6 Introduction to Development of Surfaces of Solids – Principal Developments – Parallel and Radial Developments.

Module 7 Introduction to Intersection of surfaces.

WS 151A **W O R K S H O P P R A C T I C E**

(SESSIONAL SUBJECT)

Full Marks: 100	**Contact Periods: 3S**

Module 1 CARPENTRY: Specifications of wood and wood-products; Introduction to tools and equipment; Practice jobs and different wood-joineries like half-lap joint; tenon and mortise, tenon and dove-tailed briddle joint, right angled single mitred tenon and mortis joint and haunched tenon and mortise for windows frames etc.

Module 2 FITTING: Introduction to tools; Sawing and Filling and Drilling; Preparation of simple fitting jobs including use of measuring devices.

Module 3 MASONRY: Practice of construction of brick masonry wall of English and Flemish Bond.

AR 151 **A R C H I T E C T U R A L D E L I N E A T I O N**

(SESSIONAL SUBJECT)

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Full Marks: 100 **Contact Periods: 3S**

Sheet No. 1 INDOOR SKETCHING

To practice freehand drawing of objects & figures with shades & shadows and using colours in various media such as pencil, crayons, watercolour and poster colour.

Sheet No. 2 OUTDOOR SKETCHING

To practice freehand drawing of a building along with sky, trees, cars, human figures etc. with shades & shadows and using colours in various media such as pencil, crayons, watercolour and poster colour.

Sheet No. 3 ARCHITECTURAL PRESENTATION & RENDERING OF CARS

To practice presentation and rendering of both plans & elevations, in Black & White and in colour.

Sheet No. 4 ARCHITECTURAL PRESENTATION & RENDERING OF HUMAN FIGURES

To practice presentation and rendering of both plans & elevations, in Black & White and in colour.

Sheet Nos. 5 & 6 ARCHITECTURAL PRESENTATION & RENDERING OF LANDSCAPE ELEMENTS
To practice presentation and rendering of TREES, HERBS, SHRUBS, GROUND COVERS, CONTOURS & WATER BODIES as a single entity, and in clusters / groups in association with built forms, both in plans & elevations, in Black & White and in colour.

AR 152 BASIC DESIGN

(SESSIONAL SUBJECT)

Full Marks: 150 **Contact Periods: 6S**

Module 1 COLOUR SCHEMES

GENERAL PRINCIPLES OF COLOUR BASED ON ITS DIFFERENT QUALITIES & SCHEMES AND THEIR REPRESENTATION THROUGH COLOUR-WHEELS.

Module 2 TWO DIMENSIONAL COMPOSITION

TWO-DIMENSIONAL COMPOSITION OF GEOMETRICAL SHAPES BASED ON PRINCIPLES OF DESIGN.

Module 3 THREE DIMENSIONAL COMPOSITION

THREE-DIMENSIONAL COMPOSITION OF SIMPLE GEOMETRICAL FORMS BASED ON PRINCIPLES OF DESIGN.

Module 4 MODULAR COMPOSITION

COMPOSITIONS BASED ON THE PRINCIPLES OF RATIO, PROPORTION AND MODULE.

Module 5 THEME SCULPTURE DESIGN & MODELLING

PREPARATION OF SCULPTURE(S) BASED ON SOME THEME APPLYING THE DIFFERENT ELEMENTS AND PRINCIPLES OF DESIGN USING MATERIALS SUCH AS CLAY, PLASTICENE, G.I. WIRE, MOUNT BOARD ETC.

Module 6 STUDY & ANALYSIS

Study and Analysis of simple functional spaces of a small residential building based on areas & dimensions, furniture & fixtures — Representation through Bubble Diagram, Plan(s), Elevation(s) & Section(s).

AR 153 DESCRIPTIVE GEOMETRY & MODELLING PRACTICE – I

(SESSIONAL SUBJECT)

Full Marks: 150 **Contact Periods: 6S**

A. Use of Instruments, Pencils with different grade
B. Drawing presentations related to the topics under the subject

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- Design Fundamentals and Geometrical Drawing-I
- AR-103 would include the following:

1) Plane and Solid Geometry
   Drawing of point, line, elementary forms by geometrical method-1 sheet
2) Orthographic Projection
   a) Projection of point, lines, planes and solids
      (Prism, Pyramid, Cylinder, Cone etc.) – 3 sheets
   b) Sections, true shape of sections of solids – 2 sheets
3) Development of Surfaces – 2 sheets + 1 model
4) Interpenetration of Solids – 2 sheets + 1 model

CE 201A **E N V I R O N M E N T & E C O L O G Y**

Semester Examination:	**Contact Periods: (2L)**
Time – 3 hrs.	**Internal Assessment:**
Full Marks – 35	**Full marks – 15**

Module 1 Introduction

Components of environment; renewable and non-renewable resources

Module 2 Ecology

Structure and function of an ecosystem: material cycle; energy flow; food chain; food web; ecological pyramid; bio-magnification; ecological successions; major ecosystems of the earth; ecological balance and consequences of change; biodiversity and its conservation

Module 3 Water Pollution

Surface water and ground water; water pollutants – sources and effects; agricultural pollution; eutrophication; case studies; water quality standards; control of pollution

Module 4 Air Pollution

Atmospheric composition; energy balance; air pollutants – sources and effects; weather and dispersion; vehicular pollution; case studies; air quality standards; control measures; global atmospheric issues – global warming, ozone layer depletion, acid rain, indoor air pollution

Module 5 Land Pollution

Municipal, industrial, commercial, agricultural, hazardous solid waster; collection and disposal; recovery and conversion; case studies

Module 6 Noise Pollution

Classification of noise; the decibel; frequency characterization; noise criteria (L_{eq}, L_N); standards; control measures

Module 7 Other Environmental Issues

From unsustainable to sustainable development; environmental impact assessment, environmental impacts of urbanization; environmental impacts of selected industrial activities; clean technologies; waste minimization; water conservation; rain water harvesting; watershed management; Environment Protection Act; Water (Prevention and Control of Pollution) Act; Air (Prevention and Control of Pollution) Act, relevant international protocols and conventions; ISO 14000

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MA 202A **M A T H E M A T I C S – II A**

Semester Examination: **Contact Periods: (2L + 1T)**
Time – 3hrs. **Internal Assessment:**
Full Marks – 70 **Full marks – 30**

A. Co-ordinate Geometry:

Two dimensions
Transformation of coordinates – Translation Rotation only, Reduction of general equation of second degree.

B. Three dimensions

Coordinates, Direction Cosines, Planes, Straight lines, Spheres, Standard equations of simple surface e.g. cylinders, cones, ellipsoids, Hyperboloids etc.

C. Vector Algebra:

Sum and products of vectors, Application of Geometry and Mechanics

D. Linear Programming:

Geometrical ideas of convex sets, feasible solutions and domains etc. Fundamental theorem of LPP (statement only), Graphical methods, Applications of Simplex Algorithm.

E. Statics:

Analysis data (direct and grouped), Frequency Diagrams, Ogive, Histogram, Measures of central tendency : Mean, Median, Mode, Measures of dispersion, Skewness, Curtosis Fitting of curves (Least seuare method).

F. Differential Equations:

Second order differential equations with constants co-efficient and with variable co-efficient reducible to case constant co-efficient, applications.

AM 201A **S T R E N G T H O F M A T E R I A L S**

Semester Examination: **Contact Periods: (3L + 1T)**
Time – 3 hrs. **Internal Assessment:**
Full Marks – 70 **Full marks – 30**

Module 1 **SIMPLE STRESSES & STRAINS**

1.1 Mechanical Properties of Materials Definitions with explanations only.
1.2 Different types of loads and their effects on materials – Tensile, Compressive, Shear and Impact
1.3 Simple stresses and types of stresses
1.4 Simple strains and type of strains
1.5 Stress-strain diagram for M.S. in tensile test showing salient points such as Proportional Limit, Yield point, Elastic Limit, Ultimate points and Breaking Point.
1.6 Study of stresses – Strain diagram for Cast Iron and Dead Steel.
1.7 Modulus of Elasticity.
1.8 Ultimate stress, working stress and Factor of safety and their effect on simple designs.
1.9 Stresses in members with stepped cross section and stress in composite members.
1.10 Stress in nuts and bolts.
1.11 Temperature stress and strain.
1.12 Simple problems.

Module 2 **SHEAR FORCE & BENDING MOMENT**

2.1 Types of beams, types of supports and types of loads on beams
2.2 Definitions of B.M and S.F and their sign conventions.
2.3 Bending Moment and Shear Force diagrams of simple cases such as:
 (i) Cantilever beams with point loads and UDL.

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(ii) Simply supported beams with point loads and UDL.
(iii) Simply supported overhanging beam – one side and both sides.
(iv) Simple Problems.

Module 3 **BENDING STRESSES IN BEAMS**

3.1 Definitions of bending stress deduction of simple bending formula i.e. M/I = f/y = E/R with their usual notations (assumption made in theory of simple bending) — Neutral axis

3.2 Moment of Resistance, Section modulus and Radius of Gyration.

3.3 Related problems in bending stress for symmetrical section about axis parallel to the plane of bending.

Module 4 **DEFLECTION OF BEAMS**

4.1 Differential equation of elastic curve — Relation among deflection, slope, shear force, bending moment and rate of loading — Sign convention of slope and deflection.

4.2 Standard formula (no proof) for maximum slope of deflection in: —
(a) cantilever beam subjected to point load at free end alone & when subjected to uniformly distributed load on entire span;
(b) simply supported beam carrying a point load at mid span alone & when carrying a uniformly distributed load on entire span.

4.3 Problems related to above two cases of cantilever and simply supported beams.

Module 5 **COLUMNS**

Definitions of Columns & Struts – Long, Medium & Short columns – Effective Length – Slenderness Ratio – Critical load – Safe load — Different kinds of end conditions — Euler's formula for critical load (no proof) — Assumptions made and its limitations — Strength of columns

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AR 201 EVOLUTION OF ARCHITECTURE–I

Semester Examination: **Contact Periods: (2L)**
Time – 2 hrs. **Internal Assessment:**
Full Marks – 35 **Full marks – 15**

GROUP–A ARCHITECTURE OF ANCIENT WEST

Module 1 Prehistoric Settlements & Megalithic Constructions

A BRIEF SKETCH OF THE EVOLUTION OF ARCHITECTURAL SPACES FROM THE PREHISTORIC TIMES TO THE PRESENT DAY — DEVELOPMENT OF MEANS OF SPANNING AND FORM OF SHELTER WITH RELATION TO AVAILABLE MATERIAL THROUGH THE STONE, THE BRONZE AND THE IRON AGES — FIVE TYPES OF BUILDINGS — DETAIL STUDY OF (A) THE Catal Hüyük, Anatolia, AND, (B) THE Stonehenge at Salisbury Plain, England.

Module 2 Ancient Mesopotamia

PLENTIFUL SUPPLY OF SOIL IN THE ALLUVIAL PLAINS OF TIGRIS & EUPHRATES, KNOWLEDGE OF KILN-FIRE, SCARCITY OF STONE & TIMBER, AVAILABILITY OF BITUMEN FROM NATURAL SPRINGS – LEADING TO – UBIQUITY OF MUD BRICK LAID IN BITUMEN — CONSTRAINTS IMPOSED BY THE STRUCTURAL DEMANDS OF BRICK VAULTING, KNOWLEDGE OF TRUE ARCH – LEADING TO – Arcuated ARCHITECTURE — DETAIL STUDY OF (A) THE City of Ur, Mesopotamia (Iraq) AS CONSTRUCTED BY THE SUMERIANS, AND, (B) THE City of Babylon, Mesopotamia (Iraq) AS RECONSTRUCTED BY NEBUCHADNEZZAR II.

Module 3 Ancient Egypt

BELIEF IN AFTER-LIFE, POWERFUL PRIESTHOOD, ABUNDANT LABOUR – LEADING TO – Tomb ARCHITECTURE OF MONUMENTAL SCALE: Mastabas, Royal Pyramids AND Rock-hewn Tombs — DETAIL STUDY OF THE Great Pyramid of Cheops, Gizeh — Temples: Great Temple of Amun, Karnak, Thebes — IDEA ABOUT Pylons, Obelisks AND Sphinx.

Module 4 Mesoamerica

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PRE-COLUMBIAN AMERICA: SETTLEMENTS IN NORTH AMERICA, MESOAMERICA AND THE ANDES — The Maya: SCHEMATICS OF TYPICAL MAYAN TEMPLES — DETAIL STUDY OF THE Temple I (the Temple of the Giant Jaguar), Tikal (Guatemala) OF THE MAYA LATE CLASSIC PERIOD.

GROUP–B ARCHITECTURE OF ANCIENT INDIA

Module 5 Indus Valley Civilization

Relatively egalitarian society – Prominent features of town planning – Burnt-brick laid in mud-mortar in 'English Bond' – No instance of true arch: openings spanned by wooden lintels — Study of the CITY OF MOHEN-JO-DARO, INDUS VALLEY (PAKISTAN) with reference to its GREAT BATH and GREAT GRANARY.

Module 6 Vedic Village

Outcome of migration, unrelated to the Indus Valley Civilization – Elementary type of forest dwelling leading to TIMBER CONSTRUCTION – *GRAMA* (little collection of huts) protected by bamboo railing: *THABA* (post), *SUCHI* (needle), *GAMADVARA* (entrance), *TORANA* (gateway)

Module 7 *Stupa* Architecture

Supreme sacred monument of Buddhism – Basic form: solid domical mound crowned by an *chhatra* (umbrella) – More monumental *stupas*: surrounded by *vedika* (railing) with *toranas* (gateways) at cardinal points — Detailed study of the GREAT *STUPA* (*STUPA* 1), SANCHI

Module 8 Rock-cut Architecture

8.1 PILLARS: Plain unornamented circular shaft – campaniform capital – circular abacus with animal motif – Study of the LION CAPITAL, SARNATH, UTTAR PRADESH.

8.2 EARLY ROCK-CUT ARCHITECTURE: Simple woodwork imitating forms – Study of the LOMASH RISHI CAVES, BARABAR HILLS, BIHAR.

8.3 ORISSAN GROUP (JAIN): Monastic retreat only without any chaitya or stupa – semicircular arches with simple brackets – Study of the RANI GUMPHA, UDAYAGIRI, ORISSA.

8.4 HINAYANA PHASE: Necessity of monasteries suitable for congregational worship, forbiddance of worship of Buddha's image - leading to - Chaityagriha & Vihara hewn out of rock, introduction of symbolic forms – translation of carpentry forms into stones, horseshoe-arch-gable – Study of the CHAITYA HALL, KARLI, MAHARASHTRA.

8.5 MAHAYANA PHASE: Influence of Hinduism – introduction of image – change in disposition of inner most cells of Vihara serving as monastery as well as sanctuary – Study of the AJANTA CAVE NO. 19, MAHARASHTRA.

8.6 FINAL PHASE (BRAHMINICAL): Gradual elaboration of interior from primitive singular cell to isolated cell with ambulatory – culmination in emulation of structural temple – Study of the KAILASA TEMPLES, ELLORA, MAHARASHTRA.

REFERENCE BOOKS

1. A History of Architecture (Century Edition) / Sir Banister Fletcher / Butterworth Heinemann (Hb), CBS (Pb)
2. Indian Architecture Vol. 1 (Buddhist & Hindu) / Percy Brown / D.B. Taraporevala
3. Buddhist and Hindu Architecture in India / Satish Grover / CBS
4. A World History of Architecture / Marian Moffett, Michael Fazio & Lawrence Wodehouse / McGraw-Hill
5. Encyclopedia of Architectural Technology / Ed: Pedro Guedes / McGraw-Hill
6. The Story of Architecture FROM ANTIQUITY TO THE PRESENT / Jan Gympel / KÖNEMANN (Pb)
7. The Great Ages of World Architecture / G. H. Hiraskar / Dhanpat Rai.

AR 202 MATERIALS & METHODS OF CONSTRUCTION–II

Semester Examination: **Contact Periods: (3L)**
Time – 3 hrs. **Internal Assessment:**

Full Marks – 70 **Full marks – 30**

G R O U P - A M A T E R I A L S

Module 1 CEMENT CONCRETE

1.1 Concrete: Definition
1.2 Concrete making materials: Cement – Portland Cement – Types of Portland Cement: Pozzolona Cement – White Cement – Blast furnace slag cement (properties and uses only) – Storage of cement — Aggregates – Grading of aggregates: Fine & Coarse aggregate (definition & function) — Water – Properties of water to be mixed with cement – Functions of water
1.3 Properties of concrete: Strength – Durability – Water-cement ratio – Workability
1.4 Defects of concrete and their curing measures
1.5 Principal types of concrete: Plain Cement Concrete (PCC) & Reinforced Cement Concrete (RCC) — Their advantages & properties

Module 2 NON- CONVENTIONAL CONCRETE

Precast concrete – Pre-stressed concrete – FRC – Ferrocement (definitions and applications only)

Module 3 BUILDING MORTARS

Classification of mortars on the basis of materials used and their functions: Cement mortar – Lime mortar – Mud mortar – Composite mortars (Lime-Cement mortar, *Surki*-Lime mortar) – Gypsum mortar

G R O U P - B C O N S T R U C T I O N

Module 4 BUILDING HARDWARE

Fixing and fastening for doors and windows: Nails – Screws – Hinges – Bolts – Rivets – Handles

Module 5 DOORS

5.1 Types of doors based on operation (concepts only): Swing door – Revolving door – Sliding door – Sliding-folding door – Collapsible door – Rolling shutter door – Fire door
5.2 Doors of timber (in detail): Panelled & glazed door – Flush door: solid & hollow-core
5.3 Doors of steel (in detail): Rolling shutter door
5.4 Doors of aluminium (in detail): Swing door – Sliding door

Module 6 WINDOWS

6.1 Types of windows based on operation (concepts only): Fixed window – Casement window – Sliding window – Pivoted window – Louvered (or Venetian) window – Bay window – Clerestory window – Corner window – Dormer window
6.2 Windows of timber (in detail): Panelled & glazed timber casement window
6.3 Windows of steel (in detail): Glazed fixed & casement steel window
6.4 Windows of aluminium (in detail): Sliding aluminium window

R E F E R E N C E B O O K S

1. Building Construction Volume I, II, III & IV (Metric Ed.) / J. K. McKay & W. B. McKay / Orient Longman
2. The Construction of Buildings Volume 1, 2, 3, 4 & 5 / R. Barry / English Language Book Society
3. A Text Book of Building Construction / S. P. Aurora & S. P. Bindra /
4. Building Construction / Sushil Kumar / Standards Publishers Distributors, Delhi
5. A Text Book of Materials and Construction / TTTI

AR 203 A R C H I T E C T U R A L D E S I G N & D E S C R I P T I V E G E O M E T R Y

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Semester Examination:	**Contact Periods: (1L + 1L)**
Time – 6hrs.	**Internal Assessment:**
Full Marks – 70	**Full marks – 30**

MODULE 1 ARCHITECTURAL DESIGN

DEFINITIONS OF BASIC TERMINOLOGIES

Definitions of the terms "BALCONY", "BUILDING", "*CHAJJA*", "*CHOWK* OR COURTYARD", "*CHOWK*, INNER", "*CHOWK*, OUTER", "COVERED AREA", "GARAGE, PRIVATE", "GARAGE, PUBLIC", "OPEN SPACE", "OPEN SPACE, FRONT", "OPEN SPACE, REAR", "OPEN SPACE, SIDE", "PARAPET", "PARKING SPACE", PARTITION", "PLINTH', "PLINTH AREA", "STOREY", "STOREY, TOPMOST", "VERANDAH", "WATER-CLOSET", "WINDOW" as per the NBC.

DESIGN PRINCIPLES

Design principles of SMALL STRUCTURES like Class Rooms, Gate *Gumty*, Way-side Bus Stops, Snacks' Corners, Children's Playlots, Small Cafeteria etc.; and, that of SMALL RESIDENCES (A-2 category of occupancy of the NBC) like residences of an architect, doctor, lawyer, musician, dancer etc.

MODULE 2 DESCRIPTIVE GEOMETRY

Theoretical classes on the topics covered in the syllabus of the sessional subject "Descriptive Geometry & Modelling Practice – II".

AR 251 ARCHITECTURAL DESIGN & DRAWING

(SESSIONAL SUBJECT)

Full Marks: 200	**Contact Periods: 9S**

Undertaking architectural design of any two topics from the Module 1 and any one topic from the Module 2 in sketch-wise phases: —

Module 1 — Small Structures: Class Rooms, Gate *Gumty*, Way-side Bus Stops, Snacks' Corners, Children's Playlots, Small Cafeteria etc.

Module 2 — Small Residences **(A-2 category of occupancy of the NBC): Residences of an architect, doctor, lawyer, musician, dancer etc.**

While evolving the design, ideas should be given regarding the following:

(a) **site analysis basically dealing with 'location', 'orientation', 'access' and 'parking';**
(b) **influence of materials on form of architecture.**

The design should be presented through a set of architectural drawings in a suitable scale consisting of at least the following sheets:—

(a) site layout showing approach roads to the site, internal road approaching the designed space(s), open parking spaces (if any), planting and landscaping (wherever applicable);
(b) plans showing furniture layout, parking spaces (if any), planting and landscaping (wherever applicable);
(c) elevation(s);
(d) minimum two sectional elevations cutting at least the toilet(s), stairs and any other service area (if any).

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The drawings should be suitably rendered in monochrome for one design and in colour for the other.

AR 252 DESCRIPTIVE GEOMETRY & MODELLING PRACTICE – II

(SESSIONAL SUBJECT)

Full Marks: 150 **Contact Periods: 6S**

Drawing presentations related to the topics under the Module 2 of the subject – Architectural Design & Descriptive Geometry (AR-203), which would include the following:—

1) Isometric & Axonometric Projection – 2 sheets
2) Sciography – 2 sheets
3) Principle of Perspective Drawing – 8 sheets
4) Modelling – Preparation of one model of a physical design under the subject Architectural Design & Drawing (AR-204).

AR 253 DETAILS OF CONSTRUCTION PRACTICE – I

(SESSIONAL SUBJECT)

Full Marks: 100 **Contact Periods: 4S**

SHEET NO. 1 STUDY OF BRICKS

BRICKS OF DIFFERENT SIZE: F.P.S. or Ordinary bricks, Metric Bricks — TERMS ASSOCIATED WITH A BRICK: Arris, Bed, Header, Stretcher, Face, Frog or Kick, Bed Joints, Course, Quoin, Stopped or Closed End, Vertical Joints, Perpends — PORTIONS OF A BRICK: Bat (Half bat, Three-quarter bat, Bevelled bat large, Bevelled bat small) – Closer (Queen closer, Queen closer half, Queen closer quarter, King closer, Bevelled closer, Mitred closer) – Bullnose – Splay (Splay stretcher, splay header) — Drawing the above in suitable combination and scale.

SHEET NO. 2 ENGLISH BOND

Preparing drawings of English Bond of ONE AND ONE & HALF BRICK RIGHT QUOINS and SQUARE STOPPED ENDS in suitable scales — Preparing drawings of an English Bonded TEE JUNCTION between a single brick external wall and a half brick internal wall — Preparing drawings of an English Bonded CROSS JUNCTION between a single brick wall and an one & half brick wall.

SHEET NO. 3 FLEMISH & CBRI BOND

Preparing drawings of Double Flemish Bond of ONE AND ONE & HALF BRICK RIGHT QUOINS and SQUARE STOPPED ENDS in suitable scales — Preparing drawings of CBRI Bond of ONE BRICK SQUARE STOPPED END in suitable scale.

SHEET NO. 4 SINGLE & DOUBLE SHUTTER TIMBER PANEL DOORS WITH & WITHOUT BEADING

TOPIC A: DOUBLE SHUTTER TIMBER PANEL DOOR WITH BEADING WITH SCHEDULE*
TOPIC B: SINGLE SHUTTER TIMBER PANEL DOOR WITHOUT BEADING WITH SCHEDULE*

Following drawings of each of the above: —

(i) SECTIONAL PLAN showing width of masonry & clear opening, inside outside, sizes of frames stile & panel thickness (in 1 : 50 scale);
(ii) FRONT ELEVATION showing height of masonry & clean opening, door clearance, width of top, bottom & lock rails, position of lock & hinge handles, fastened bolt (in 1 : 50 scale);
(iii) SECTIONAL ELEVATION showing above (in 1 : 50 scale);
(iv) (a) Typical detail showing fixing of frame to wall, stile, panel with beading; (b) same as above without beading; (c) overlapping of shutters (in 1 : 2 scale).

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SHEET NO. 5 HOLLOW & SOLID CORE TIMBER FLUSH DOORS

TOPIC A: SINGLE SHUTTER TIMBER HOLLOW CORE FLUSH DOOR WITH SCHEDULE*
TOPIC B: SINGLE SHUTTER TIMBER SOLID CORE WITH SCHEDULE*

Following drawings of each of the above: —

(i) SECTIONAL PLAN – same as panel door except panel showing core (in 1 : 50 scale);
(ii) FRONT ELEVATION – same as panel door (in 1 : 50 scale);
(iii) SECTIONAL ELEVATION – same as panel door (in 1 : 50 scale);
(iv) (a) Typical detail – showing same as panel door (except panel) with hollow cover;
(b) Same as above with solid core (both removing a part of Venetian).

SHEET NO. 6 ALUMINIUM GLAZED DOOR (WITH SCHEDULE*)

Following drawings of each of the above: —

(i) SECTIONAL PLAN – same as panel door, except panels(in 1:50 scale)
(ii) FRONT ELEVATION – same as panel door, except panels (in 1:50 scale)
(iii) SECTIONAL ELEVATION - same as panel door, except panels (in 1:50 scale)
(iv) (a) Typical details sectional plan – same as panel door;
(b) Vertical sectional detail of fixing glass with aluminium frame (in 1:2 scale)

* Schedule of the above doors will include masonry opening, frame size, shutter details viz. size of stile, top, bottom & lock rail, panel thickness, remarks specifying no. of shutter, material, specification handle, bolt, hinge, lock.

SHEET NO. 7 DOUBLE SHUTTER TIMBER GLAZED & PANELLED CASEMENT WINDOWS

Following drawings of each of the above: —

(i) SECTIONAL PLAN showing width of masonry & clear opening, inside outside, size of frame, stile, thickness of glass (in 1 : 50 scale);
(ii) FRONT ELEVATION – Showing height of masonry & clean opening, width of sash bar, handle fastener, bolt, hinge (1 : 50 scale);
(iii) SECTIONAL ELEVATION – Showing same as above (in 1 : 50 scale);
(iv) (a) Typical detail showing fixing of frame with wall, stile with glass panel;
(b) Vertical section of joining glass with sash bar (in 1:2 scale).

SHEET NO. 8 METAL CASEMENT WINDOWS

TOPIC A: MILD FIXED & OPENABLE GLAZED STEEL CASEMENT WINDOW

Following drawings of each of the above: —

(i) Sectional plan;
(ii) Front elevation;
(iii) Sheet elevation (1:10);
(iv) Detail showing: (a) overlapping of shutter with mullion; (b) joining of frame to wall; (c) fixing of glass to sash bar;
(v) Determination of Z, T & I section (1:1).

TOPIC B: ALUMINIUM SLIDING WINDOW

Following drawings of each of the above: —

(i) Section plan;
(ii) Front elevation;
(iii) Sectional elevation showing all the menu;
(iv) Detail – Same as above and section of channel.

CE 301 A STRUCTURAL ENGINEERING – I

Semester Examination: **Contact Periods: (2L + 1T)**

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Time – 3 hrs. **Internal Assessment:**
Full Marks – 70 **Full marks – 30**

Theory of structures; Review of stresses on beams; Composite beams; Deflection in beams; Determinate and Indeterminate beams;

Energy methods and their applications in beam problems; Theory of columns; Short and long columns; Empirical formulae;

CE 302 A **S U R V E Y I N G**

Semester Examination: **Contact Periods: (2L)**
Time – 2 hrs. **Internal Assessment:**
Full Marks – 35 **Full marks – 15**

Chain surveying; Principles, Methods of linear measurement; Instruments for Chaining; Chaining over uneven ground; Chaining tape corrections including sag corrections; Chain triangulation; Selection of stations, locating ground features; Plotting of chain survey' determination of area by chain survey, setting out of a building.

Compass survey; Use of prismatic compass; Chain and Compass traversing, Plotting compass traverse;

Plane table survey; Introduction and method; Errors in plane tabling;

Leveling; Adjustment of dumpy level; Reciprocal leveling and profile leveling; Countering and interpolation of contour maps;

3rd & 4th semester B.Arch. Courses

AR 301 **E V O L U T I O N O F A R C H I T E C T U R E – I I**

Semester Examination: **Contact Periods: (3L)**
Time – 3 hrs. **Internal Assessment:**
Full Marks – 70 **Full marks – 30**

G R O U P - A EVOLUTION OF TEMPLE ARCHITECTURE IN INDIA

Module 1 Earliest Temples

ROOF SUGGESTING TIMBER & THATCH ORIGIN – LATER ADDITION OF TOWER & PILLARED PORCH – SQUARE SHAFT WITH 'CUSHION' CAPITAL – LACK OF PROPORTION – STUDY OF THE **Lad Khan Temple, Aihole** — EVOLUTION OF **structured temple:**

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***VIMANA* (SHRINE) WITH *SIKHARA* (TOWER), *GARBHAGRIHA* (SANCTUM), *MANDAPA* (ASSEMBLY HALL), *ANTARALA* (VESTIBULE), *PRADAKSHINA PATHA* (AMBULATORY) – Two main styles: DRAVIDIAN & INDO-ARYAN**

Module 2 Temple Architecture of Southern India: Dravidian Style

2.1 PALLAVA: Origin from rock-cut architecture – mandapa or pillared hall with a cell – Study of the monolithic RATHAS, MAMMALLAPURAM

2.2 Chola: Simplicity in treatment – lofty vimana – pillared mandapa aligned axially within walled enclosure – 'kalasa' capital replacing Pallava Lion capital

2.3 Pandya: Concentric walls enclosing prakarana (open courtyards) – introduction of gopuram (temple portal)

2.4 Vijaynagar: Elaboration in ceremony – addition of Amman shrine & 'Kalyan' mandapa

2.5 Madura: Two main temple formations: (a) inner flat-roofed courtyard with vimana thrusting above, and, (b) outer open courtyard – rectangular plan enclosed within high boundary wall with series of gopuram – interior pillars with foliated or gryphon brackets – Study of the MEENAKSHI TEMPLE, MADURA.

Module 3 Temple Architecture of Northern India: Indo-Aryan Style

3.1 ORISSA GROUP**:** Separate nomenclature (*Deul, Pista etc.*) – Wall enclosing axially aligned structures without pillars – interiors devoid of ornamentations – exteriors decorated with figure sculptures – Study of the LINGARAJA TEMPLE, BHUBANESWARA

3.2 KHAJURAHO GROUP**:** Elegantly proportioned detached temples without enclosing wall in 'Latin cross' plans – separate domical roofs gradually increasing in height grouped centripetally – rich surface ornamentation – Study of the KANDARYA MAHADEVA TEMPLE

3.3 PROVINCIAL STYLES OF BENGAL**:** Origin in wooden houses & thatched bamboo huts – parabolic roofs and cornices or eaves suitable to drain rainwater – wide & short pillars with arched openings – square panelled terracotta relief – Study of the JOR-BANGLA TEMPLE, BISHNUPUR

3.4 JAIN TEMPLES: Exuberantly curved white marbles on vaulted ceilings surrounded by high enclosing walls of cells, enshrining statues of 'Jina' – open portico & vestibule leading to enclosed shrine with octagonal nave – obscured structural consideration – Study of the DILWARA TEMPLE, MOUNT ABU

G R O U P - B EVOLUTION OF ISLAMIC ARCHITECTURE IN INDIA

Module 4 Beginning of Islamic Architecture in India

Vocabulary of typical Islamic Architecture in India: PERSIAN ORIGIN – ARCUATED ARCHITECTURE – MORTAR-MASONRY – POINTED ARCHES – DOMES – STALACTITE CORBELS – ARABESQUE – STONE GRILL & PIERCED SCREEN – ESSENTIAL OF A TYPICAL INDIAN MOSQUE – COMPONENTS OF A TYPICAL TOMB BUILDING — STUDY OF THE Qutb Complex, Old Delhi

Module 5 The Sayyid & Lodhi Dynasties and The Buildings of Sher Shah Sur

Sayyid & Lodi Dynasties: TWO FORMS OF TOMBS – (A) SINGLE STORIED OCTAGONAL TOMB SURROUNDED BY ARCHED VERANDA, AND, (B) TWO / THREE STORIED SQUARE TOMB WITHOUT VERANDA; BOTH MOUNTED BY DOMES, RANGE OF PILLARED KIOSK OVER PARAPET — Study of the Tomb of Sher Shah: GRAND FULFILMENT OF THE LODI STYLE – HARMONIOUS TRANSITION FROM SQUARE FORM OF LOWER STOREYS TO DIMINISHING OCTAGONAL FORMS SURMOUNTED BY CIRCULAR BASE OF CROWNING HEMISPHERICAL DOME WITH FINIAL

Module 6 Provincial Style of Bengal

BRIEF REFERENCE TO THE FIRST TWO PHASES: BRICK STRUCTURES NECESSITATING ARCUATED STYLE – SHORT PILLARS SUPPORTING POINTED 'DROP' ARCHES & VAULTS IN BRICK — TYPICAL FEATURES OF THIRD PHASE: CURVILINEAR FORM OF ROOF ORIGINATING FROM THATCHED BAMBOO HUT FACILITATING WATER DRAINAGE – STUDY OF (A) THE Eklakhi Tomb, Pandua, AND, (B) THE Qadam Rasul Masjid, Gaur

Module 7 The Mughal architecture

7.1 EARLIER SANDSTONE PHASE: BABAR & HUMAYUN: Beginning of garden tomb – Study of the HUMAYUN'S TOMB — AKBAR: Style executed in red sandstone with insertion of marble – trabeated construction system with frequent use of four-centred arch giving visual impression of arcuated style – hollow dome – many sided pillars with bracket capital – carving or bold inlay ornamentation with

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occasional painted design – Study of PLANNING FEATURES OF THE FATEHPUR SIKRI: The politics of Architecture – Visual Unity through sandstone – Symmetry around multiple axes – Study of (a) the DIWAN-I-KHAS, and, (b) the BULAND DARWAJA

7.2 LATER MARBLE PHASE: JAHANGIR: Keener interest towards nature than in buildings – Formal Mughal Gardens in Kashmir – Study of the SHALIMAR GARDEN, KASHMIR — SHAHJAHAN: Age of marble – fine & restrained moulding – inlaid pattern of decoration in coloured stone – dome assuming Persian bulbous form constricted at neck – system of true double doming – voluted bracket capital & foliated base of pillions – Study of the (a) RED FORT emphasising planning & design of the DIWAN-I-AM; and, (b) the TAJ MAHAL emphasising on both TOMB and GARDEN

REFERENCE BOOKS

1. **Indian Architecture Vol. 1 (Buddhist & Hindu) / Percy Brown / D.B. Taraporevala Sons & Co. Pvt. Ltd.**
2. **Indian Architecture Vol. 2 (Islamic Period) / Percy Brown / D.B. Taraporevala Sons & Co. Pvt. Ltd.**
3. **Islamic Architecture in India / Satish Grover / Galgotia Publishing Company, New Delhi**
4. **Buddhist and Hindu Architecture in India / Satish Grover / CBS**
5. **A History of Architecture / Sir Banister Fletcher / Butterworth Heinemann (Hb), CBS (Pb)**
6. The Great Ages of World Architecture / G. H. Hiraskar / Dhanpat Rai
7. A World History of Architecture / Marian Moffett, Michael Fazio & Lawrence Wodehouse / McGraw-Hill

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AR 302 MATERIALS & METHODS OF CONSTRUCTION–III

Semester Examination:	**Contact Periods: (3L)**
Time – 3 hrs.	**Internal Assessment:**
Full Marks – 70	**Full marks – 30**
Semester Examination:	**Contact Periods: (3L)**
Time – 3 hrs.	**Internal Assessment:**
Full Marks – 70	**Full marks – 30**

Module 1 Foundation & Plinth

4.1 FOUNDATION: Definition – Purpose

4.2 CLASSIFICATION OF FOUNDATION: Shallow Foundation & Deep Foundation

4.3 SPREAD FOOTINGS: Wall Footings – Reinforced Concrete Footings – Inverted Arch Footings – Isolated Column Footings — COMBINED FOOTING — MAT OR RAFT FOUNDATION (Concepts with sketches)

4.4 TYPICAL DETAILS OF FOUNDATION: (i) Brick wall foundation & (ii) Isolated RCC column foundation

4.5 PLINTH: Definition – Purpose

4.6 FILLING OF PLINTH: Materials used – Methods of filling – Purpose of filling

Module 2 Damp Proofing Treatment

5.1 DAMPNESS — CAUSES of dampness — DEFECTS caused by dampness

5.2 METHODS OF PREVENTION OF DAMPNESS: Membrane Damp Proofing – Integral Damp Proofing – Surface Treatment – Guniting – Cavity Wall Construction

5.3 DAMP PROOFING TREATMENT TO: (i) Foundation & plinth & (ii) Basement

Module 3 Spanning of Openings

3.1 Post & Lintel openings — Limitations of material — Arched openings

3.2 LINTEL AND ARCH: Definitions – Typical detail of a masonry window opening showing sill, lintel & *chajja* projection – Typical detail of an arched opening showing various parts

3.3 TYPES OF LINTEL: Brick lintel — RCC lintel — Precast concrete lintel (with or without *chajja*)

3.4 TYPES OF ARCHES: Semi-Circular Arches — Segmental Arches — Flat Arches

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3.5 RELIEVING ARCHES

Module 4 Stairs

4.1 STAIRS: Definition – Technical terms used in stairs construction
4.2 LOCATION of Stairs
4.3 REQUIREMENT of a good stair
4.4 RISER & TREAD RELATIONSHIP
4.5 CLASSIFICATION of stairs on the basis of their forms
4.6 RCC STAIRS: Advantages of RCC stairs – Design Principle of RCC stairs
4.7 FIXING DETAILS: (i) Balusters (metal & wood) & (ii) Nosing to steps

Module 5 Upper Floors

5.1 Suspended floors in timber – single
5.2 R.C.C. FLOORS: Slab (one-way, two-way & cantilever) – Beam & slab – Flat Slab – Ribbed floor
5.3 PRE-CAST CONCRETE FLOOR

Module 6 Pitched Roofing

6.1 Technical terms associated with pitched roof construction
6.2 Types of pitched roofs: Lean-to-roof – Coupled roof – Closed couple roof – King Post Roof Truss – Queen Post Roof Truss
6.3 Steel trusses up to 40 ft. span
6.4 Roofing materials: Tiles – Corrugated Galvanised Iron sheet — Their fixing details
6.5 Roof drainage through gutter

REFERENCE BOOKS

1. **Building Construction Volume I, II, III & IV (Metric Ed.) / J. K. McKay & W. B. McKay / Orient Longman**
2. **The Construction of Buildings Volume 1, 2, 3, 4 & 5 / R. Barry / English Language Book Society**
3. **Building Technology & Valuation / S. Arthanari et al of TTTI, Madras / Tata McGraw-Hill**
4. **A Text Book of Building Construction / S. P. Aurora & S. P. Bindra /**
5. **Building Construction / Sushil Kumar / Standards Publishers Distributors, Delhi**

AR 303 **CLIMATOLOGY**

Semester Examination:	**Contact Periods: (2L)**
Time – 2 hrs.	**Internal Assessment:**
Full Marks – 35	**Full marks – 15**

MODULE 1 **COMFORTABLE BUILT ENVIRONMENT: ORIENTATION OF BUILDINGS**

CLIMATE & WEATHER — BASIC CLIMATIC ZONES: Hot & Arid, Hot / Warm & Humid, Cold — CLIMATIC FACTORS: Solar Radiation & Temperature, Clouds, Relative Humidity, Prevailing wind; measuring instruments and SI units — FEATURES OF DWELLINGS IN TROPICS: Aspects of Daylighting, Plantation of trees.

MODULE 2 **COMFORT: THE DESIRABLE CONDITIONS**

REQUIREMENT OF VENTILATION — HEAT BALANCE OF BODY: Fanger's comfort equation — Thermal Comfort Chart — Sun Path Diagram — Comfort Zone & Bio-Climatic Chart — Comfort Range — AIR CHANGE PER HOUR — RECOMMENDED VALUES of Air Changes for different occupancies as per the NBC [values only] — METHODS OF VENTILATION

MODULE 3 **PRINCIPLES OF THERMAL DESIGN**

Thermal quantities – Heat flow, heat flow rate, density of heat flow rate — Sol-air temperature — Solar gain factor — HEAT EXCHANGE PROCESS: Conduction – Convection – Radiation through windows – Evaporation — Calculation of heat loss & heat gain — Cooling & heating by air — Transmittance of Composite Walls, Thermal Gradient

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MODULE 4 MEANS OF THERMAL CONTROL: NATURAL VENTILATION

Principle of nature ventilation in buildings — WIND ACTION: Q = KAV — STACK EFFECT: Q = 7.0A $\sqrt{h\,(t_r - t_o)}$ — CROSS-VENTILATION — POSITION OF OPENINGS – SIZE OF OPENINGS — CONTROL OF OPENINGS: Sashes, Canopies, Louvers — WIND SHADOW — HUMIDITY CONTROL: Wind Scoop

MODULE 5 MEANS OF THERMAL CONTROL: STRUCTURAL CONTROLS

SOLAR CONTROL: Internal Blinds & Curtains – Heat absorbing Glasses — SUN'S POSITION: Effects of Angle of Incidence – Stereographic Projection – Shadow Angles — SHADING DEVICES: Vertical & Horizontal – Design of Shading Devices

MODULE 6 PRINCIPLES OF LIGHTING

AIMS OF GOOD LIGHTING and realization of the same — PLANNING THE BRIGHTNESS PATTERN considering the VISUAL TASK, the immediate background of the task (CENTRAL FIELD & VISUAL FIELD) and the general surroundings (PERIPHERAL FIELD) — GLARE: direct, reflected & veiling — RECOMMENDED VALUES OF ILLUMINATION LEVEL for different occupancies as per the NBC [values only]

MODULE 7 DAYLIGHTING

SOURCES OF LIGHT OF A POINT INSIDE A BUILDING: skylight, externally reflected light, internally reflected light, direct sunlight — WORKING PLANE — DAYLIGHT FACTOR — COMPONENTS OF DAYLIGHT FACTOR: SC, ERC, IRC — DAYLIGHT PENETRATION

REFERENCE BOOKS

1. **SP 7 (4) : 1983 NATIONAL BUILDING CODE OF INDIA group 4 – part viii building services / Bureau of Indian Standards**
2. **Manual of Tropical Housing and Building Part 1 Climatic Design / O. H. Koenigsberger, T. G. Ingersoll, A. Mayhew, S. V. Szokolay / Orient Longman**
3. **M. Evans – Housing, Climate and Comfort – Architectural Press, London, 1980.**
4. **B. Givoni, Man, Climate and Architecture, Applied Science, Banking, Essex, 1982.**
5. **Donald Watson and Kenneth Labs., Climatic Design – McGraw Hill Book Company – New York, 1983**

AR 304 **PLUMBING SERVICES**

Semester Examination:	**Contact Periods: (3L)**
Time – 3 hrs.	**Internal Assessment:**
Full Marks – 70	**Full marks – 30**

Module 1 Water Supply

1.1 **WATER SUPPLY: SOURCES & REQUIREMENTS**

GROUND WATER — SPRINGS: Gravity Springs, Artesian Springs – WELLS: Open Wells, Artesian Wells, Tube Wells (Shallow / Deep) – INFILTRATION WELLS & GALLERIES — SURFACE WATER — WATER SUPPLY REQUIREMENTS for — 'residences', 'restaurants', 'cinemas & theatres', 'day schools', 'boarding schools', 'hostels', 'hospitals (including laundry)', 'offices' [per capita per day consumption value only]

1.2 **POTABLE WATER & ITS SUPPLY**

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WATER TREATMENT: Screening – Plain Sedimentation – Coagulation & Sedimentation – Filtration – Disinfection – Softening – Aeration [Definitions & Sequence only] — DIRECT & INDIRECT SYSTEM — CONSTANT OR CONTINUOUS & INTERMITTENT SUPPLY

1.3 **DESIGN OF WATER DISTRIBUTION SYSTEMS**

GENERAL REQUIREMENTS OF WATER DISTRIBUTION SYSTEM — ESTIMATE OF DEMAND LOAD: Occupant Load, Fire Protection — BASIC PRINCIPLES OF WATER DISTRIBUTION WITHIN THE PREMISES — WATER MAIN — SERVICE PIPE: Ferrule, Goose-neck, Stop-cock box, Water-meter box – Communication Pipe – Consumer's Pipe

1.4 **STORAGE OF WATER & DOWNTAKE DISTRIBUTION PIPES**

REQUIREMENT for storage — QUANTITY to be stored — MATERIALS used — UNDERGROUND & OVERHEAD RESERVOIRS — DOWNTAKE TAPS (COLD WATER DROPS)

Module 2 Sanitation & Drainage

2.1 **SANITATION REQUIREMENTS**

WASH BASINS (flat-back) — CLEANER'S SINK — DRINKING WATER FOUNTAIN — WATER CLOSETS: Squatting type & Sitting type — URINAL – MALE: Bowl type (flat back or angle back), Slab type, Stall type – FEMALE: Squatting plate type — FLUSHING CISTERNS — BATHS — SHOWERS — NUMBER OF SANITATION REQUIREMENTS for different occupancies as per the NBC — LAYOUT DRAWINGS: students should be able to read orthographic & isometric projections of toilets-kitchens-WCs etc fitted with the above mentioned sanitations

2.2 **HOUSE DRAINAGE PIPES**

SOIL PIPE: Main Soil Pipe, Branch Soil Pipe — WASTE PIPE: Main Waste Pipe, Branch Waste Pipe, Rain Water Pipe — MAIN SOIL WASTE PIPE, BRANCH SOIL WASTE PIPE — VENTILATING PIPE: Main Ventilating Pipe, Branch Ventilating Pipe, Drain Ventilating Pipe, Anti Siphonage Pipe — VENT PIPE — JUNCTION PIPE

2.3 **PLUMBING SYSTEM**

TWO-PIPE SYSTEM — ONE-PIPE SYSTEM — SINGLE STACK SYSTEM — PARTIALLY VENTILATED SINGLE STACK SYSTEM — CHOICE OF PLUMBING SYSTEM

2.4 **TRAPS**

TRAP: Water seal, Essentials of a good trap, Causes of loss or breaking of water seal — CLASSIFICATION OF TRAPS: Based on shape (P, Q, S); Based on use/ location (Floor trap, Gully trap, Intercepting trap, Grease trap, Silt trap)

2.5 **CHAMBERS**

INVERT — COLLECTION CHAMBER — GULLY CHAMBER — INSPECTION CHAMBER — MANHOLE — DROP MANHOLE — INCEPTOR MANHOLE OR INTERCEPTOR MANHOLE — MANHOLE CHAMBER

2.6 **DESIGN CONSIDERATIONS FOR DRAINAGE SYSTEM**

SEWAGE: soil waste, waste water (sullage), storm water (rain water) — SOLID REFUSE — CHANNEL — DRAIN — DRAINAGE — SEWER — SEWERAGE — AIMS OF DESIGNING A DRAINAGE SYSTEM & REALIZATION OF THE SAME — SYSTEMS OF SEWAGE DISPOSAL: Dry or conservancy system (earth closets, trench latrines, bore-hole latrines, sanitary latrines); Water carriage or drainage system — SIZING OF RAIN-WATER PIPES FOR ROOF DRAINAGE — QUANTITY OF SEWAGE: DWF — SYSTEMS OF DRAINAGE: Separate system, Combined system, Partially separate system — CIRCULAR & EGG-SHAPED SEWERS

2.7 **DISPOSAL OF SEWAGE FROM ISOLATED BUILDINGS**

SEPTIC TANK: Sludge & Scum — DESIGN CONSIDERATIONS: capacity (detention period, sludge removal, consumption of water) – shape & dimensions; inlet & outlet; baffle wall; cover & manholes; ventilation; lining — DISPOSAL OF SEPTIC TANK EFFLUENT: CHLORINATION CHAMBER – SOAK PIT (LINED & UNLINED); DISPERSION CHAMBER – DISPERSION TRENCH

Module 3 Materials, Fittings & Appliances

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3.1 **VALVES, COCKS, TAPS, FIRE HYDRANTS & OTHER FITTINGS**
VALVES: Air valves or air relief valves, Reflux valves or check valves or non-return valves or flap valves or foot valves, Safety valves or pressure relief valves, Sluice valves or gate valves or stop valves, Scour valves or wash-out valves or blow-off valves, Mixing valves — STOP COCKS — TAPS: Bib taps, Self-closing taps — FIRE HYDRANTS — FITTINGS: Bends or elbows, Tees, Crosses, Wyes, Reducers, Increasers, Flanges, Caps, Plugs, Back Nuts [Definitions, sketches & applications]

3.2 **JOINTING OF PIPES & PIPE MATERIALS**
Names of different type of joints for different pipe materials with detail reference to SPIGOT & SOCKET JOINTS, FLANGED JOINTS AND CEMENT MORTAR JOINTS — LAGGING OF PIPES — SUPPLY PIPES: Cast Iron, Steel, Reinforced concrete, Pre-stressed concrete, Galvanized Mild Steel tubes, Copper, Brass, Wrought Iron, Asbestos Cement, Lead, Polythene, Unplasticized PVC — DRAINAGE PIPES: Salt Glazed Stoneware, Cast Iron, Asbestos Cement, Lead, Unplasticized PVC

REFERENCE BOOKS

1. **SP 7 (5) : 1983 National Building Code of India group 5 – Part IX Plumbing Services / BIS**
2. **Text Book of WATER SUPPLY AND SANITARY ENGINEERING / S.K. Hussain / Oxford & IBH Publishing Co.**

AR 305 **ARCHITECTURAL DESIGN–I**

Semester Examination:	**Contact Periods: (1L)**
Time – 6 hrs.	**Internal Assessment:**
Full Marks – 70	**Full marks – 30**

Module 1 **UNDERSTANDING DESIGN PRINCIPLES OF** EDUCATIONAL BUILDINGS **BELONGING TO THE GROUP B TYPE OF OCCUPANCY AS PER THE NATIONAL BUILDING CODE OF INDIA. THIS WOULD INCLUDE BUILDINGS LIKE PRE-PRIMARY, PRIMARY & SECONDARY SCHOOLS, DAY-CARE CENTRES ETC.**

Module 2 **UNDERSTANDING DESIGN PRINCIPLES OF** BUSINESS BUILDINGS **BELONGING TO THE GROUP E-1 TYPE OF OCCUPANCY AS PER THE NATIONAL BUILDING CODE OF INDIA. THIS WOULD INCLUDE BUILDINGS LIKE SMALL POST-OFFICES, SMALL BANKS, PROFESSIONAL ESTABLISHMENTS ETC.**

AR 351 **ARCHITECTURAL DESIGN PRACTICE–I**

(SESSIONAL SUBJECT)

Full Marks: 200	**Contact Periods: 9S**

Undertaking architectural design of any two topics, one each from the Modules 1 & 2 in sketch-wise phases keeping in mind the provisions regarding "Open Spaces" and "Parking Space": —

Module 1 — Educational Buildings (Group – B category of occupancy of the NBC): Pre-primary, Primary & Secondary Schools, Day-care Centres etc.

Module 2 — Business Buildings **(Group – E-1 category of occupancy of the NBC): Small Post-Offices, Small Banks, Professional establishments etc.**

While evolving the design, ideas should be given regarding the following:

(c) **site analysis basically dealing with 'location', 'orientation', 'access' and 'parking';**
(d) **influence of materials on form of architecture.**

The design should be presented through a set of architectural drawings in a suitable scale consisting of at least the following sheets:—

(e) **site layout showing approach roads to the site, internal road approaching the designed space(s), open parking spaces (if any), planting and landscaping (wherever applicable);**
(f) **plans showing furniture layout, parking spaces (if any), planting and landscaping (wherever applicable);**
(g) **elevation(s);**
(h) **minimum two sectional elevations cutting at least the toilet(s), stairs and any other service area (if any).**

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<u>The drawings should be suitably manually rendered in monochrome for one design and in colour for the other.</u>

AR 352 DETAILS OF CONSTRUCTION PRACTICE–II

(SESSIONAL SUBJECT)

Full Marks: 100 **Contact Periods: 4S**

SHEET NO. 1 **SKIN SECTION**

Typical skin section through a two storied building on — (a) load bearing brick wall, and, (b) RCC framed structure, in 1: 50 scale.

SHEET NO. 2 **DETAILS OF FOUNDATION**

Details of typical foundations up to plinth levels for the above two skin sections in — (a) Brickwork & (b) RCC showing typical damp proof treatments in foundation and plinth in suitable scale, minimum scale being 1:25.

SHEET NO. 3 **DETAILS OF SPANNING OF OPENINGS**

Details of different typical methods of spanning of openings by — (a) Sill, (b) Lintel, and, (c) Semi-circular arch in suitable scale, minimum scale being 1:25. Details at sill and lintel levels are to be prepared in reference to the skin section drawn in Sheet no. 1.

SHEET NO. 4 **DETAILS OF PARAPET**

Details of a typical parapet showing coping, parapet wall, blocking course, cornice and frieze in suitable scale, minimum scale being 1:25. Details are to be prepared in reference to the skin section drawn in Sheet no. 1.

SHEET NO. 5 **DETAILS OF RCC STAIRS**

Details of a typical RCC staircase showing fixing details of — (a) Balusters (metal & wood), and, (b) Nosing to steps in suitable scale, minimum scale being 1:25.

SHEET NO. 6 **DETAILS OF PITCHED ROOFING**

Details of a typical pitched roof on steel trusses (up to 40 ft. span) showing their fixing details and roof drainage through gutter; roofing materials being — (a) Tiles, and, (b) Corrugated Galvanised Iron sheet. The scale of reference plan and reference section be drawn in minimum 1:50 scale, and, other details at ridge, eaves etc. in suitable scale, minimum scale being 1:25.

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AR 353 COMPUTER PRACTICE – I

(SESSIONAL SUBJECT)

Full Marks: 50 **Contact Periods: 3S**

Module 1 INTRODUCTION TO COMPUTER SYSTEMS HARDWARE, SOFTWARE AND PROGRAMMING LANGUAGE.
Module 2 INTRODUCTION TO OPERATING SYSTEMS.
Module 3 INTRODUCTION TO COMPUTER GRAPHICS.
Module 4 INTRODUCTION TO BASIC COMPUTING.
Module 5 FUNDAMENTALS OF 2-DIMENTIONAL DRAWING IN CAAD. BASIC DRAWING FEATURES. BASIC EDITING TOOLS.
Module 6 DIMENSIONING AND TEXT FORMATTING.
Module 7 PRINTING AND PLOTTING TECHNIQUES.
Module 8 PROJECT WORK.

AR 371 EDUCATIONAL TOUR & DOCUMENTATION – I

(SESSIONAL SUBJECT)

Full Marks: 50 **Contact Duration: 12 days**

Educational Tour & Documentation – I includes submission of study report on field tour of maximum 12 days' duration conducted by the Department. Classes during the Educational Tour, if held beyond vacations, would remain suspended.

CE 401 A STRUCTURAL ENGINEERING – II

Semester Examination: **Contact Periods: (2L + 1T)**
Time – 3 hrs. **Internal Assessment:**
Full Marks – 70 **Full marks – 30**

Steel structures; Permissible stresses; Design of truss members; Simple riveted and welded connections including beam-end connections;

Built-up beams and columns; Design of base-plate, gasset plate and concrete footings for steel columns; Grillage foundation;

Reinforced concrete; Permissible stresses, Rectangular, T and L beams; Double reinforced beams; One way slab; Columns and isolated footings; Design of lintels and Chajjas; Cantilever beams; Distribution of base pressure; Middle third rules; earth pressure; Design of simple retaining wall; Cantilever retaining wall.

EE 401 A ELECTRICAL SERVICES

Semester Examination: **Contact Periods: (2L)**
Time – 3 hrs. **Internal Assessment:**
Full Marks – 35 **Full marks – 15**

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Fundamentals of electricity, current, voltage; Distribution of electric power in towns / cities and house hold connections;

Elements of building wiring system – feeders, panel board, circuit breakers' fuses, switches etc.; Electrical symbols;

Installations from meter board to individual point; Electrical wiring system; Distribution boards and layout of points; Different materials and specification; Earthling agreements; Lighting conductors;

Fixtures and accessories used in electrical installation; Schematic layout of installations and points for different building types;

Methods of lighting; Direct, Indirect, suspended, portable, concealed lighting; Decorative lighting, Flood lighting; Calculation of artificial lighting by various methods.

AR 401 EVOLUTION OF ARCHITECTURE–III

Semester Examination:	**Contact Periods: (3L)**
Time – 3 hrs.	**Internal Assessment:**
Full Marks – 70	**Full marks – 30**

GROUP - A THE CLASSICAL EUROPEAN ARCHITECTURE

Module 1 ARCHITECTURE OF THE CLASSICAL GREECE

Abundance of high quality limestone & marble, scarcity of hardwood, restriction on building spanning, expression of direct democracy, Mediterranean climate – leading to – COLUMNAR & TRABEATED architecture, HUMAN SCALE, EXTROVERT SPACE — ORDERS: DORIC, IONIC, CORINTHIAN — Elements of urban architecture: ACROPOLIS AT ATHENS with idea about AGORA, STOA, BOULEUTORION, THEATRE, ODEION, STADIUM, HIPPODROME AND GYMNASIA — Detail study of the PARTHENON, THE TEMPLE TO ATHENA with emphasis to its (a) Elevation: facade treatment, proportion (Golden section, optical correction); (b) Plan: PRONAOS, NAOS & STATUE AND OPISTHODOMOS OR EPINAOS.

Module 2 ARCHITECTURE OF THE CLASSICAL ROME

Introduction of FIRED BRICK, use of IMPROVED MORTAR analogous to modern concrete, judicious use of different quality of stone, STUCCO & MARBLE VENEERING; knowledge of TRUE ARCH, BARREL & CROSS VAULTS, CUPOLA & COFFER CEILING, expression of majesty of the Imperial Empire, financial resources from conquests – leading to – ARCUATED ARCHITECTURE, MONUMENTAL SCALE, GRANDEUR, INTROVERT SPACE — ORDERS added: TUSCAN and COMPOSITE or ROMAN — Comparative proportions of the Classical Orders — Idea about the TEMPLES, FORUM, BASILICAS, THERMAE & BALNEAE, THEATRE, AMPHITHEATRE, CIRCUSES, TRIUMPHAL ARCHES & COLUMNS, AQUEDUCTS & BRIDGES — Detail study of the PANTHEON, ROME with emphasis to section through its great dome.

GROUP - B THE EVOLUTION OF CHURCH ARCHITECTURE

Module 3 EARLY CHRISTIAN ARCHITECTURE

Acceptance of Christianity by Constantine, need for enclosed religious congregational space, lack of resources & skilled craftsmen, adaptation of existing building elements – leading to – BASILICAN CHURCHES — Detail study of the BASILICA OF ST. PETER, ROME with emphasis to its (a) Plan: SINGLE AXIS from ENTRANCE to the APSE through NAVE & AISLE, and, (b) Section: SYSTEM OF SPANNING & CLERESTORY LIGHTING.

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Module 4 **BYZANTINE ARCHITECTURE**

Difference in the nature of Christ, knowledge of placing a dome over a regular polygonal plan with PENDENTIVES, TWO AXES – leading to – Orthodox Churches with square plan, enclosing nave & aisle in the shape of GREEK CROSS, use of large opening creating radiant interior — Detail study of the HAGIA SOPHIA, CONSTANTINOPLE.

Module 5 **ROMANESQUE ARCHITECTURE**

Consolidation of Papal hierarchy, desire to articulate, to stress or underline every structural division in order to produce unified compositions, continuing development of STONE VAULTING into GROINED SYSTEMS – leading to – development of church plan as a LATIN CROSS with addition of TRANSEPTS, extension of aisles carried round APSIDAL SANCTUARY to form AMBULATORY, FIGURATIVE & NON-FIGURATIVE SCULPTURES designed and integrated with structure & construction — Detail study of the PISA CATHEDRAL WITH BAPTISTERY & CAMPANILE.

Module 6 **GOTHIC ARCHITECTURE**

Medieval age, supremacy of religion, desire to create lofty towered cathedrals, mystic interiors; knowledge to cut & shape stone, entire structure conceived as framework of organised coherent system of POINTED ARCHES & VAULTS – leading to – rectangular church plans with high PINNACLES, dramatic external massing of light & shadow, TRACERY admitting defused light, reduction of structural function of wall to a minimum — Detail study of the NOTRE DAME, PARIS with emphasis to its (a) Plan showing NAVE & CHOIR and, (b) transverse section showing POINTED ARCH, FLYING BUTTRESS, NAVE ARCADE & TRIFORIUM.

Module 7 **RENAISSANCE ARCHITECTURE**

Reformation movement in Christianity, decline of temporal power of the Church; revival of classical learning resulting in symbolism, plain forms of church with uncluttered interiors – STUCCO widely used for decorative interiors – Increasing refinement and systematisation of architectural drawing – Detail study of the evolution of the plan of the CATHEDRAL OF ST. PETER, ROME — BAROQUE: movement, spatial invention, drama and freedom of detail – Detail study of PIAZZA OF ST. PETER, ROME — ROCOCO.

REFERENCE BOOKS

1. A History of Architecture (Century Edition) / Sir Banister Fletcher / Butterworth Heinemann (Hb), CBS Publishers & Distributors (Pb)
2. The Story of Architecture FROM ANTIQUITY TO THE PRESENT / Jan Gympel / KÖNEMANN (Pb)
3. A World History of Architecture / Marian Moffett, Michael Fazio & Lawrence Wodehouse / McGraw-Hill
4. Encyclopedia of Architectural Technology / Ed: Pedro Guedes / McGraw-Hill
5. CRASH COURSE IN ARCHITECTURE / Eva Howarth / Caxton Editions
6. The Great Ages of World Architecture / G. H. Hiraskar / Dhanpat Rai

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AR 402 MATERIALS & METHODS OF CONSTRUCTION–IV

Semester Examination:	**Contact Periods: (3L)**
Time – 3 hrs.	**Internal Assessment:**
Full Marks – 70	**Full marks – 30**

GROUP - A **CONSTRUCTION**

Module 1 **PARTITION WALLS (BRICK MASONRY)**

Definition – Types – Uses – Simple details of construction

Module 2 **FALSE CEILINGS (SUSPENDED TYPE)**

Definition – Types – Uses – Simple details of construction

Module 3 **CURTAIN WALLS**

Definition – Uses – Simple details of construction

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Module 4 WATER PROOFING TREATMENT

4.1 Water proofing treatment to FLAT ROOFS & TERRACES: (a) Grading of Bitumen: Four course treatment – Six course treatment — (b) Grading of other materials: Grading of lime concrete – Grading of lime concrete with tiles – Grading of mud *pushka* with tiles (brief description with detail sketch)

4.2 Water proofing treatment to Parapet Wall: Detail of Coping, Drip course / Mould

4.3 Water proofing treatment to Window Sill & Chajja: Detail of Drip course / Mould

Module 5 FORMWORKS

5.1 Definition – materials used in formwork – requirements of good formwork

5.2 Rules to be followed in the removal of formwork at different locations

5.3 Formwork: Steel & Timber – Their comparison

GROUP - B MATERIALS

Module 6 FINISHES

6.1 FLOOR FINISHES: Cement Concrete Flooring (IPS), Terrazzo Flooring, Ceramic Flooring, Stone Flooring, Marble & Granite Flooring, Acid-Proof Flooring, PVC Flooring, Timber Parquet Flooring

6.2 WALL AND CEILING FINISHES: INTERNAL PLASTERING: CEMENT PLASTER, GYPSUM PLASTER OR PLASTER OF PARIS, GYPSUM PLASTER BOARD — EXTERNAL PLASTERING: CEMENT PLASTER (SMOOTH WOOD FLOAT FINISH, PEBBLE DASH FINISH, TEXTURED FINISH, ROUGH CART FINISH OR SPONGE FINISH) — POINTING — WHITE WASHING & COLOUR WASHING — WALL CLADDING (DADO & SKIRTING): WOOD, BRICK TILES, CERAMIC TILES, STONE TILES (MARBLE & GRANITE)

6.3 PAINTS: Constituents – Functions – Types

Module 7 ADHESIVES

7.1 Names of adhesives used for bonding of surfaces of wood, metal, glass and plastic

7.2 Functions, Properties & Types

REFERENCE BOOKS

1. Building Construction Volume I, II, III & IV (Metric Ed.) / J. K. McKay & W. B. McKay / Orient Longman
2. The Construction of Buildings Volume 1, 2, 3, 4 & 5 / R. Barry / English Language Book Society
3. Building Technology & Valuation / S. Arthanari et al of TTTI, Madras / Tata McGraw-Hill
4. A Text Book of Building Construction / S. P. Aurora & S. P. Bindra /
5. Building Construction / Sushil Kumar / Standards Publishers Distributors, Delhi

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AR 403 LANDSCAPE & SITE PLANNING

Semester Examination:	**Contact Periods: (3L)**
Time – 3 hrs.	**Internal Assessment:**
Full Marks – 70	**Full marks – 30**

Module 1 INTRODUCTION

Definition of Landscaping — Role of landscaping and landscape architect in architecture — Evolution of Landscaping: Oriental and Occidental — Relationship of man, building and landscaping — Elements of landscaping: Natural & Man-made

Module 2 EVOLUTION OF GARDEN PATTERNS

2.1 ORIENTAL: West Asiatic & East: Babylon, Persia, Mughal — Far East: Chinese & Japanese

2.2 OCCIDENTAL: English & French

2.3 MODERN GARDEN PATTERNS: Rock Garden – Indoor Garden – Terrace Garden

Module 3 ELEMENTS OF LANDSCAPING

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3.1 NATURAL ELEMENTS OF LANDSCAPING: Rock & Landform — Water — Plants: Different types of trees, shrubs, ground covers & climbers with their characteristics mentioning the basis of their selection for different purposes

3.2 MANMADE ELEMENTS OF LANDSCAPING: Materials, construction details and maintenance of the following manmade elements of landscaping:—

(a) Paving: Hard and soft – Layout for formal and informal paving – Different kinds of paving materials: soil, stabilized murrum, brick & stone etc.

(b) Outdoor Furniture – Outdoor Light Fixtures – Signage & Signboard – Sculpture – Fences

(c) Artificial Rock – Artificial Waterfall

Module 4 GUIDELINES FOR LANDSCAPING OF SPECIFIC AREAS

4.1 RESIDENTIAL: Individual and group of buildings

4.2 COMMERCIAL: Shopping Mall

4.3 RECREATIONAL: Parks and Play Areas

4.4 PUBLIC SPACES: Plaza, Precinct and Squares

Module 5 SITE PLANNING

5.1 Need, Definition and Scope for Site Planning

5.2 Relationship in between Site Planning and Landscaping

5.3 Principles of Site Planning

5.4 Landform: Layout and maintenance of drainage – Layout and standards of road and pedestrian paths

REFERENCE BOOK

1. TIME-SAVER STANDARDS FOR LANDSCAPE ARCHITECTURE / Dines & Harris / McGraw-Hill
2. LANDSCAPE ARCHITECT'S PORTABLE HANDBOOK / N. Dines / McGraw-Hill
3. Landscape Architecture / J. O. Simonds / Lliffee, London
4. Designs of the Landscape / Preece / CBS
5. Landscape Detailing Vol. I / M. Little wood / CBS
6. Landscape Detailing Vol. II / M. Little wood / CBS
7. Landscape for Living / G. Eckbe / F. W. Dodge Corporation, N.Y.
8. Kevin Lynch – Site Planning – MIT press, Cambridge
9. Sylvia Crowe Sheila Haywood, The Gardens of Mughal India, Vikas Publishing House
10. Testsuro Yoshida, Gardens of Japan, Jr. Marcus G. Sims, 1963
11. John O. Sinurds – Earthscape, McGraw Hill Book Co., New York

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AR 404 ARCHITECTURAL DESIGN–II

Semester Examination:	**Contact Periods: (1L)**
Time – 6 hrs.	**Internal Assessment:**
Full Marks – 70	**Full marks – 30**

MODULE 1 **DEFINITIONS OF BASIC TERMINOLOGIES**

Definitions of the terms "BUILDING, HEIGHT OF", "CARPET AREA", "HABITABLE ROOM", "LEDGE OR TAND", "LIFT", "LOFT" and "MEZZANINE FLOOR" as per the NBC.

MODULE 2 **DESIGN PRINCIPLES**

Understanding design principles of —

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(a) **Residential Buildings** belonging to the Group A-5 type of Occupancy as per the National Building Code of India. This would include buildings like Inns, Clubs, Motels, Detached Bungalow, Resorts etc.; and,

(b) **Assembly Buildings** belonging to the Group E-1 type of Occupancy as per the National Building Code of India. This would include buildings like Exhibition Halls, Art Galleries, Lecture Halls, Skating Rinks, Gymnasiums, Restaurants, Club Houses etc. accommodating less than 300 persons.

AR 451 ARCHITECTURAL DESIGN PRACTICE–II

(SESSIONAL SUBJECT)

Full Marks: 200 **Contact Periods: 9S**

Undertaking architectural design of any two topics, taking one each from any two of the Modules 1, 2 & 3 in sketch-wise phases keeping in mind the provisions regarding "COVERED AREA", "PLINTH AREA", "GROUND COVERAGE", "Open Spaces" and "Parking Space": —

Module 1 — Residential Buildings (Group A-5 category of occupancy of the NBC): Hotels, Inns, Clubs, Motels, Detached Bungalow, Resorts etc.

Module 2 — **Small** Institutional Buildings **(Group C-1 category of occupancy of the NBC): Primary Health Centre etc.**
Module 3 — Assembly Buildings **(Group D-4 category of occupancy of the NBC): Exhibition Halls, Art Galleries, Lecture Halls, Skating Rinks, Gymnasiums, Restaurants, Club Houses etc. accommodating less than 300 persons.**

While evolving the design, ideas should be given regarding the following:

(i) **site analysis basically dealing with 'location', 'orientation', 'access' and 'parking';**
(ii) **influence of materials on form of architecture.**

The design should be presented through a set of architectural drawings in a suitable scale consisting of at least the following sheets:—

(i) site layout showing approach roads to the site, internal road approaching the designed space(s), open parking spaces (if any), planting and landscaping (wherever applicable);
(j) plans showing furniture layout, parking spaces (if any), planting and landscaping (wherever applicable);
(k) elevation(s);
(l) minimum two sectional elevations cutting at least the toilet(s), stairs and any other service area (if any).

The drawings should be suitably manually rendered in monochrome for one design and in colour for the other.

AR 452 DETAILS OF CONSTRUCTION PRACTICE–III

(SESSIONAL SUBJECT)

Full Marks: 100 **Contact Periods: 4S**

SHEET NO. 1 PARTITION WALL

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Details of typical brick partition walls showing masonry openings in suitable scale, minimum scale being 1:25

SHEET NO. 2 **FALSE CEILING**

Details of suspended type false ceilings in suitable scale, minimum scale being 1:25

SHEET NO. 3 **CURTAIN WALL**

Details of curtain walls using suitable scale, minimum scale being 1:25

SHEET NO. 4 **WATER PROOFING TREATMENT ON FLAT ROOFS & TERRACES USING BITUMEN**

Details of water proofing treatments to flat roofs and terraces using bitumen in four courses and six courses of grading showing rain water pipe. Drawings are to be drawn in suitable scale, minimum scale being 1:25

SHEET NO. 5 **WATER PROOFING TREATMENT ON FLAT ROOFS & TERRACES USING LIME CONCRETE**

Details of water proofing treatments to flat roofs and terraces using lime concrete on flat tiles showing rain water pipe. Drawings are to be drawn in suitable scale, minimum scale being 1:25

SHEET NO. 6 **WATER PROOFING TREATMENT TO PARAPET WALL, WINDOW SILL & CHAJJA**

Details of water proofing treatments to parapet walls, window sills and chajja showing coping, drip course, moulds etc. Drawings are to be drawn in suitable scale, minimum scale being 1:25

AR 453 **COMPUTER PRACTICE–II**

(SESSIONAL SUBJECT)

Full Marks: 50 **Contact Periods: 3S**

Module 1 **ADVANCED 2-DIMENTIONAL DRAWING AND EDITING.**

Module 2 **USE OF BLOCK AND ATTRIBUTES.**

Module 3 **USE OF BLOCK AND W BLOCK.**

Module 4 **INTRODUCTION TO 3-DIMENSIONAL DRAWING. BASIC 3D DRAWING AND EDITING FEATURES.**

Module 5 **USER COORDINATE SYSTEM.**

Module 6 **INTRODUCTION TO RENDERING TECHNIQUES.**

Module 7 **PROJECT WORK.**

AR 454 **LANDSCAPE PRACTICE**

(SESSIONAL SUBJECT)

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Full Marks: 50 **Contact Periods: 3S**

Module 1 LANDSCAPING OF A RESIDENTIAL SPACE

Students are required to prepare landscaping schemes for a given residential space which has a recreational space attached to it in the form of a park and / or a playground. Each student is to select his or her site in consultation with the teacher-in-charge, which may be designed by the student in the previous semesters or a one designed by any other architect collected from primary or secondary source. In any case, credit is to be given to the landscaping scheme, and, not to the architectural design of the built space.

Drawings are to be presented in suitable scale providing information regarding the natural and / or manmade elements used along with necessary details of construction wherever necessary. The drawings should be restricted to three half-imperial sheets.

Module 2 LANDSCAPING OF A COMMERCIAL / RECREATIONAL SPACE

Each student is required to prepare landscaping schemes for a given commercial / recreational space which may or may not have a public space attached to it in the form of a plaza or a square. The design is to be supplied by the teacher-in-charge. Credit is to be given to the landscaping scheme, and, not to the architectural design of the built space.

Drawings are to be presented in suitable scale providing information regarding the natural and / or manmade elements used along with necessary details of construction wherever necessary. The drawings should be restricted to three half-imperial sheets.

REFERENCE BOOK

1. TIME-SAVER STANDARDS FOR LANDSCAPE ARCHITECTURE / Dines & Harris / McGraw-Hill
2. LANDSCAPE ARCHITECT'S PORTABLE HANDBOOK / N. Dines / McGraw-Hill
3. Landscape Architecture / J. O. Simonds / Lliffee, London
4. Designs of the Landscape / Preece / CBS
5. Landscape Detailing Vol. I / M. Little wood / CBS
6. Landscape Detailing Vol. II / M. Little wood / CBS
7. Landscape for Living / G. Eckbe / F. W. Dodge Corporation, N.Y.

CE 471 A **SURVEY PRACTICE**

(Sessional Subject)

Full Marks: 200 **Contact Duration: 10 days**

Surveying practical includes demonstration on field on the topics under the purview of the subject – SURVEYING – CE 302(A). The demonstration and practical shall be of 10 days' duration to be conducted by the Department of Civil Engineering at the beginning of the semester.

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HU 501 A **PROFESSIONAL VALUES & ETHICS**

Semester Examination: **Contact Periods: (2L)**
Time – 2 hrs. **Internal Assessment:**
Full Marks – 35 **Full marks – 15**

1. INTRODUCTION: Definitions, objectives and issues in Value and Ethics
2. Considering ETHICAL DILEMMA — Concept of RELATIVE VALUES: social, professional and ethical — Importance of values and ethics in CORPORATE WORLD
3. Formulation of APPROPRIATE STRATEGIES incorporating value and ethics
4. DEMOCRATIC VALUES: Issues in governance and responsibility
5. Promotion of values in PUBLIC SERVICES
6. INDIAN VALUE SYSTEM – Its application in corporate life
7. Values and ethics – FROM LORE TO SCIENCE
8. Role of value and ethics in the wider SOCIAL PERSPECTIVE
9. National and international CASE STUDIES in value and ethics
10. Seminar lectures by eminent PRACTITIONERS from various fields

BASIC READING

- Alger, et al, Ethical Problems in Engineering, Wiley, New York, 1965
- Baum, R. J., ed., Ethical Problems in Engineering, Second Edition, Volume Two: Cases, Center for the Study of the Human Dimensions of Science and Technology, Rensellaer Polytechnic Institute, Troy, New York, 1980
- Bennett, F. L., The Management of Engineering: Human, Quality, 2nd Ed., Prentice-Hall, Englewood Cliffs, NJ 1989
- Chackraborty, S. K., The Management and Ethics Omnibus, Oxford University Press, New Delhi, 2001
- Callahan, J. C., ed., Ethical Issues in Professional Life, Oxford University Press, New York, 1988
- Chalk, R., Franke, M. and Chafer, S. B., AAAS Professional Ethics Project: Professional Ethics Activities of the Scientific and Engineering Societies, American Association for the Advancement of Science, Washington D. C., December, 1980
- Chevron Corporation, Our Business Conduct: Principles and Practices, 1986
- Jackall, R., Moral Mazes: The World of Corporate Managers, Oxford university Press, 1988
- Petroski, H. To engineer is Human: the Role of Failure in Successful Design, St. Martin Press, New York, 1982
- Popper, The Open Society and Its Enemies, Vol. 1 Routledge and Kegan Paul, London, 1980
- Rachels, J., The Elements of Moral Philosophy, Random House, New York, 1986
- Thomas J. M., Ethics and Techno culture, University Press of America, Lanham, MD, 1987
- Unger, S. H., Controlling Technology: Ethics and the Responsible Engineer, Holt, Rinehart and Winston, New York, 1982
- Westphal, D., Westphal, F., Planet in Peril: Essays in Environmental Ethics, Harcourt Bracer College Publishers, Orlando, FL 32887, 1994

CE 501 A **STRUCTURAL ENGINEERING – III**

Semester Examination: **Contact Periods: (2L + 1T)**
Time – 3 hrs. **Internal Assessment:**
Full Marks – 70 **Full marks – 30**

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Theory of structures; Indeterminate beams, trusses and portal beams; Moment distribution method;

Reinforced concrete; Two way slabs; Continuous beams; Columns with moment; Flat slab, Grid floor; Column footings – Combined footing, Raft foundation; Pile foundation;

Study of I.S. and Design Codes.

ME 501 A **MECHANICAL SERVICES**

Semester Examination:	**Contact Periods: (2L)**
Time – 2 hrs.	**Internal Assessment:**
Full Marks – 35	**Full marks – 15**

Module 1 MECHANICAL VENTILATION

FAN: propeller & centrifugal — INSTALLATION OF FANS: local & central — SYSTEMS OF VENTILATION: exhaust, plenum (positive ventilation) & combined — FILTERS: dry, wet, washing & electrostatic — Determining Rate of Ventilation

Module 2 AIR-CONDITIONING

Properties of air and water vapour mixture – Psychometric Charts – MECHANICAL COOLING (HEAT- PUMP CIRCUIT): refrigerant, compressor, condenser, pressure release valve, evaporator — REFRIGERATOR & AIR COOLER — SIMPLE AIR-CONDITIONER: propelling, filtering, washing, humidifying, cooling, dehumidifying, heating or re-heating — TON OF REFRIGERATION — Cooling and Heating loads for summer and winter air-conditioning — Simple load calculation of air-conditioning system in building — BUILDING INSTALLATION OF AIR-CONDITIONERS: central handling, local handling & induction system — CONTROL SYSTEMS: sensors, control unit, servo-mechanisms

Module 3 INSTALLATION OF LIFTS

3.1 **Essential Parts of Lifts:** Lift – Lift Floor – Mezzanine – Mezzanine Floor – Lift Landing – Storey – Subsidiary Storey(s) – Basement Storey – Nomenclature of Floors and Storeys – Total Headroom – Lift Travel – Lift Landing Call Push – Lift Landing Door – Lift Car – Lift Door – Call Indicator – Lift Suspension Ropes – Lift Guides – Lift Well – Lift Pit – Lift Well Enclosure – Lift Rated Load – Lift Rated Speed – Lift Contract Speed – Lift Machine – Lift Overhead Beam.

3.2 **Classification of Lift:** Passenger Lift – Goods Lift – Hospital Lift – Service Lift (Dumb waiter) – Fireman's Lift

3.3 **Design Considerations:** Number of Lifts & Capacity: Occupant load, Quantity of service, Quality of service, Car speed, Determination of handling capacity — Positioning of lifts — Shape & size of lift car — Access to machine room & lift pits — Safety measures

Module 4 INSTALLATION OF ESCALATORS

Essential Requirements: Angle of Inclination – Width – Placement location – Handrails – Step Treads – Landing – Combplates — Rated Load – Design Factor of Safety

Module 5 FIRE-FIGHTING

5.1 **General Classification:** Criteria of Fire Resistance — Combustible Material — OCCUPANCY or Use Group — TYPES OF CONSTRUCTION

5.2 **General Requirements of Fire Protection:** MAXIMUM HEIGHT — FAR — OPEN SPACES: additional provisions for high rise buildings, MIXED OCCUPANCY — FIRE WALL, FIRE STOP OR ENCLOSURE of all openings — AUTOMATIC FIRE DETECTION & ALARM SYSTEM — FIXED FIRE FIGHTING INSTALLATIONS/ REQUIREMENTS for A, B & C occupancy buildings: Wet riser, Wet riser-cum-downcomer, Automatic sprinkler installation, Static reservoir, Dry riser.

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5.3 **Exit Requirements:** TYPES OF FIRE EXITS — GENERAL EXIT REQUIREMENTS — OCCUPANT LOAD — CAPACITY OF EXITS — ARRANGEMENT OF EXITS: travel distance — DOORWAYS — CORRIDORS & PASSAGEWAYS — INTERNAL STAIRCASES — FIRE ESCAPES OR EXTERNAL STAIRS — ROOF EXIT — HORIZONTAL EXITS — FIRE TOWER — RAMPS

R E F E R E N C E B O O K S

1. SP 7 (4) **:** NATIONAL BUILDING CODE OF INDIA 2005, GROUP 4 – PART VIII BUILDING SERVICES / Bureau of Indian Standards
2. Manual of Tropical Housing and Building Part 1 Climatic Design / O. H. Koenigsberger, T. G. Ingersoll, A. Mayhew, S. V. Szokolay / Orient Longman
3. William H. Severns and Julian R. Fellows, Air-conditioning and Refrigeration, John Wiley and Sons, London, 1988
4. A.F.C. Sherrat, Air Conditioning and Energy Conservation, The Architectural Press, London, 1980

AR 501 C O N T E M P O R A R Y A R C H I T E C T U R E – I

Semester Examination:	**Contact Periods: (3L + 1T)**
Time – 3 hrs.	**Internal Assessment:**
Full Marks – 70	**Full marks – 30**

G R O U P – A I N D U S T R I A L R E V O L U T I O N

Module 1 IMPACT OF INDUSTRIAL REVOLUTION

New social outlook of the common man in the POST INDUSTRIAL REVOLUTION ERA – VICTORIAN attitude denouncing the past – Need for larger span and taller structure – Availability of new building materials: STEEL, IRON & GLASS – Modern methods of production and modern transport – GREAT EXHIBITIONS of 19th century and achievements in engineering skills – Study of the (i) CRYSTAL PALACE, LONDON (1851) by SIR JOSEPH PAXTON **–** Culmination of Early Victorian technology, and, (ii) EIFFEL TOWER, PARIS (1889) by ALEXANDRE GUSTAVE EIFFEL **–** Development of structural iron, new language of lattice structures, the open girder.

Module 2 REBELLION AGAINST THE MACHINE

2.1 ARTS & CRAFTS **:** Late 19th century English movement reviving handicrafts and reforming architecture by using traditional building crafts & local materials – Study of the BARN, EXMOUTH, DEVON (1897) by E.S. PRIOR**:** Organic relationship of a building to its locality.

2.2 ART NOUVEAU **:** Decorative movement in European architecture – Flowing & sinuous naturalistic ornament – Avoidance of historical architectural traits – Study of: (i) HÔTEL TASSEL, NO. 6, RUE PAUL-EMILOE-JANSON, BRUSSELS (1893) or HÔTEL SAVOY, NO. 224, AVENUE LOUIS, BRUSSELS (1895) – both by VICTOR HORTA; and, (ii) CASA BATLLÓ, BARCELONA (1906) or CASA MILÁ, BARCELONA (1910) – both by ANTONIO GAUDI Y CORNET.

G R O U P – B M O D E R N A R C H I T E C T U R E

Module 3 FUNCTIONALISM

3.1 DEVELOPMENTS IN AMERICA **:** (a) CHICAGO SCHOOL**:** Need for optimising the use of available floor space – Invention of the electric lift, telephone & tubular post – Beginning of the skyscrapers – THEME: FORM FOLLOWS FUNCTION – Study of the CARSON PIRIE SCOTT, CHICAGO (1904) by LOUIS HENRY SULLIVAN — (b) PRAIRIE SCHOOL**:** Open plan – Functionalist in approach – Organic Style: local material & local characteristics – Technology in the service of humanity – Stress of horizontals and

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low, long lines – Easy access between indoor & outdoor – Study of the ROBIE HOUSE, CHICAGO (1910) by FRANK LLOYD WRIGHT.

3.2 DEVELOPMENTS IN EUROPE : BAUHAUS SCHOOL: Open plan – Programmatic Functionalist approach leading to rational simplicity – Anti-ornament ethics: absolute plainness of solid blocks, exposed steel frames, walls of glass, rectilinear boxes with no visible roof – Study of the (i) FAGUS BOOT FACTORY, ALFELDAN-DER-LEINE, GERMANY (1911) by WALTER GROPIUS & ADOLF MEYER, and, (ii) BAUHAUS BUILDINGS, DESSAU, GERMANY (1926) by W. GROPIUS.

Module 4 INTERNATIONAL STYLE

Term INTERNATIONAL STYLE coined by PHILIP CORTELYOU JOHNSON in 1932 – Global uniformity of architecture – Standardisation of building elements – Asymmetrical compositions – Cubic general shapes – Study of the VILLA SAVOY, POISSY, FRANCE (1931) by LE CORBUSIER (CHARLES ÉDOUARD JEANNERET) – Extended the idea of simplicity into visual oneness leading to monolithic vision and minimalism — THEME: LESS IS MORE coined by LUDWIG MIES VAN DER ROHE – Study of the FARNSWORTH HOUSE, PLANO, ILLINOIS (1945-51) by MIES – Search for minimalism in colour, form and material pushing International Style to its limits – Study of the JOHNSON HOUSE, NEW CANAAN, CONNECTICUT (1949) by JOHNSON.

Module 5 TRIUMPH OF MODERN ARCHITECTURE

THEME: FUNCTION FOLLOWS FORM coined by MIES – To organise all functions to be sheltered and all the materials suitable for use within a form — MONOLITHICISM: Study of the UNITED NATIONS SECRETARIAT, NEW YORK (1950) by HARRISON & ABRAMOVITZ and SEAGRAM BUILDING, NEW YORK (1958) by MIES — TWIN VARIATION: Study of the NATIONAL CONGRESS BUILDING, BRASILIA (1960) by OSCAR SOARES FILHO NIEMEYER — LE MODULAR based on Golden Section: Study of the UNITÉ D'HABITATION, MARSEILLE, FRANCE (1952) and the MONASTERY OF S. MARIE-DE-LA-TOURETTE, FRANCE (1960) both by CORBUSIER

GROUP–C REVISION OF MODERNISM

Module 6 REVISION BETWEEN THE WORLD WARS

6.1 EXPRESSIONISM: Tired of plain surfaces and architectural forms – Closer to sculpture than architecture – Study of the EINSTEIN TOWER OBSERVATORY, POTSDAM, GERMANY (1921) by ERICH MENDELSOHN.

6.2 ART DECO: Name derives from a Paris exhibition of decorative and industrisal art in 1925 – Unfunctional modernism – Use of motifs from the past – Study of the CHRYSLER BUILDING, NEW YORK (1929) by WILLIAM VAN ALEN.

Module 7 MODERN ARCHITECTURE WITH A HUMAN FACE

Unison of organic architecture with international style: Study of the FALLING WATERS, BEAR RUN, PENNSYLVANIA (1939) by F. L. WRIGHT — Functionalism with psycho-physical concern: Study of the TOWN HALL, SÄYNATSÄLO, FINLAND (1952) by HUGO HENRIK AALVAR AALTO — Distinction between 'served' and 'servant' spaces: Study of the A. N. RICHARDS MEDICAL LABORATORIES, PHILADELPHIA (1961) by LOIUS I. KAHN.

REFERENCE BOOKS

1. A History of Architecture / Sir Banister Fletcher / Butterworth Heinemann (Hb), CBS (Pb)
2. The Story of Architecture FROM ANTIQUITY TO THE PRESENT / Jan Gympel / Könemann
3. Puzzle of Architecture / Robin Boyd / Melbourne Architectural Press
4. ARCHITECTURE HIGHLIGHTS! / Adams Hubertus and Paul Jochen / DUMONT monte
5. AT THE END OF THE CENTURY: ONE HUNDRED YEARS OF ARCHITECTURE / Edited by Russel Ferguson / The Museum of Contemporary Art, Los Angeles, Harry N. Abrams Inc., Publishers
6. CRASH COURSE IN ARCHITECTURE / Eva Howarth / Caxton Editions

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AR 502 M A T E R I A L S & M E T H O D S O F C O N S T R U C T I O N – I V

Semester Examination: **Contact Periods: (3L)**
Time – 3 hrs. **Internal Assessment:**
Full Marks – 70 **Full marks – 30**

Module 8 THERMAL INSULATING MATERIALS

Introduction — Types of heat insulating materials — Thermal properties of insulating materials — Methods of thermal insulation

Module 9 OTHER MATERIALS

Gypsum and allied products – Blast Furnace Slag – Fly Ash – Fibre Glass – Composite Materials

Module 10 JOINTS IN STRUCTURES

Introduction — Types of Joints: Expansion Joints, Contraction Joints, Construction Joints, Sliding Joints, Isolation joints (materials used in each type along with their details)

Module 11 MISCELLANEOUS STRUCTURES

Types of domes and vaults – Types of shell structures – Folded plates structures – Tension structures – Skeletal space frame structures – Pneumatic structures (concepts only)

Module 12 STRUCTURAL STEELWORK

Rolled sections in steel work – Methods of connecting steel work – Structural steel members and their inter-connections

Module 13 CONSTRUCTION EQUIPMENTS

Introduction — Excavation equipment – Compaction equipment – Hauling equipment – Hoisting equipment – Pumping equipment (application of the equipments mentioning the principles of operation)

R E F E R E N C E B O O K S

6. Materials for Architects and Builders: An Introduction / Arthur R Lyons / Arnold
7. A Text Book of Building Construction: Planning Techniques & Methods of Construction / Bindra & Aurora
8. Building Construction Volume I, II, III & IV (Metric Ed.) / J. K. McKay & W. B. McKay / Orient Longman
9. The Construction of Buildings Volume 1, 2, 3, 4 & 5 / R. Barry / English Language Book Society
10. Building Construction / Sushil Kumar / Standards Publishers Distributors, Delhi

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AR 503 A R C H I T E C T U R A L D E S I G N – I I I

Semester Examination: **Contact Periods: (1L)**
Time – 12 hrs. **Internal Assessment:**
Full Marks – 70 **Full marks – 30**

Module 3 **UNDERSTANDING DESIGN PRINCIPLES OF** ASSEMBLY BUILDINGS **BELONGING TO THE** GROUP D-3 TYPE OF OCCUPANCY **AS PER THE NATIONAL BUILDING CODE OF INDIA. THIS WOULD INCLUDE ANY BUILDING, WHOSE LOBBIES, ROOMS AND OTHER SPACES CONNECTED THERETO, PRIMARILY INTENDED FOR ASSEMBLY OF PEOPLE, BUT WHICH HAS NO THEATRICAL SAGE OR THEATRICAL AND OR CINEMATOGRAPHIC ACCESSORIES,**

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ACCOMMODATING 300 OR MORE PERSONS, FOR EXAMPLE, MUSEUMS, LIBRARIES, PLACES OF WORSHIP, DANCE HALLS, NIGHT CLUBS ETC.

Module 4 **UNDERSTANDING DESIGN PRINCIPLES OF** MERCANTILE BUILDINGS **BELONGING TO THE** GROUP F TYPE OF OCCUPANCY **AS PER THE NATIONAL BUILDING CODE OF INDIA. THIS WOULD INCLUDE ANY BUILDING OR PART OF A BUILDING, WHICH IS USED AS SHOPS, STORES, MARKET, FOR DISPLAY AND SALE OF MERCHANDISE, EITHER WHOLESALE OR RETAIL, FOR EXAMPLE, SHOPPING CENTRES, DEPARTMENTAL STORES, MARKETS ETC.**

AR 551 ARCHITECTURAL DESIGN PRACTICE–III

(SESSIONAL SUBJECT)

Full Marks: 250 **Contact Periods: 11S**

Undertaking architectural design of any two topics, one each from the Modules 1 & 2 in sketch-wise phases keeping in mind the provisions regarding "Open Spaces", "Area and Height Limitations", "Off-street Parking Spaces", "Norms for Planting of Shrubs and Trees": —

Module 1 — ASSEMBLY Buildings (Group D-3 category of occupancy of the NBC)**:** Museums, Libraries, Places of worship, Dance Halls, Night Clubs etc.

Module 2 — MERCANTILE Buildings **(Group F category of occupancy of the NBC): Shopping Centres, Departmental Stores, Markets etc.**

The design should be presented through a set of architectural drawings in a suitable scale consisting of at least the following sheets:—

- **(m)** **site layout showing approach roads to the site, internal road approaching the designed space(s), open parking spaces (if any), planting and landscaping (wherever applicable);**
- **(n)** **plans showing furniture layout, parking spaces (if any), planting and landscaping (wherever applicable);**
- **(o)** **elevation(s);**
- **(p)** **minimum two sectional elevations cutting at least the toilet(s), stairs and any other service area (if any);**
- **(q)** **models and views in suitable scale.**

One of the designs should be prepared manually and the other with the aid of computer aided drafting.

AR 552 WORKING DRAWING – I

(SESSIONAL SUBJECT)

Full Marks: 100 **Contact Periods: 4S**

GROUP–A LOAD BEARING STRUCTURE

A set of working drawings in 1 **:** 50 scale (unless other wise mentioned) drawn manually of a double storied load bearing structure. The architectural design may be one designed by the student in the earlier semesters, or may be supplied by the faculty-in-charge.

SHEET NO. 1 **TRENCH PLAN**

Showing: Plot line – Width of foundation trench & wall with centre-line dimensions – Footing detail of steps (in 1 **:** 20 scale) from Ground Level to Plinth Level – Staircase – Toe beam – Load bearing brick wall etc.

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SHEET NO. 2 GROUND FLOOR PLAN

Showing dimensions of all: Rooms/ spaces – Walls – Inner & outer plaster lines – Doors & windows and their positions – Width of flight – Tread – Landing – Number of treads – Width of stairwell (if any) – Position & size of RWP/ ASP/ SP/ WP/ VP – Overall dimension etc.

SHEET NO. 3 FIRST FLOOR PLAN

Same as above.

SHEET NO. 4 ROOF PLAN

Showing: *Ghundi* – Ridgeline & Slope line – Position & size of RWP/ ASP/ SP/ WP/ VP – Thickness of parapet wall – Roof projection (if any) – Sectional plan of stair room with its roof projection (if any) – Over Head Tank etc.

SHEET NO. 5 ELEVATIONS

TOPIC A: ONE ROAD SIDE ELEVATION
TOPIC B: ONE LATERAL ELEVATION

Showing: Ground Level – Plinth Level – First Floor level – Roof level – Mumpty Room Roof level – Sill & Lintel levels – Height of parapet wall – Roof projection (if any) – Specification of all other non-structural elevational feature.

SHEET NO. 6 SECTIONAL ELEVATIONS

Two sectional elevations through staircase, kitchen, toilet, front window or veranda / balcony, showing: Ground Level – Plinth Level – First Floor level – Roof level – Entrance to roof – Sill & Lintel levels – Floor slabs at all levels – Flat Brick Soling – Damp Proof Course – Parapet wall – Specification of other structural features (if any).

GROUP–B FRAMED STRUCTURE

A set of working drawings in 1 : 50 scale (unless other wise mentioned) of a G + 4 storied apartment building in simple framed structure. The architectural design may be one designed by the student in the earlier semesters, or may be supplied by the faculty-in-charge.

SHEET NO. 1 FOUNDATION

Showing: Plot line – Columns and tie-beam with centre-line dimensions – Columns & wall footing – Footing detail of steps (in 1 : 20 scale) from Ground Level to Plinth Level – Staircase – Plinth beam – Load bearing brick wall one diagonal dimension of corner columns etc.

SHEET NO. 2 GROUND FLOOR PLAN

Showing dimensions of all: Rooms/ spaces – Walls – Inner & outer plaster lines – Doors & windows and their positions– Width of flight – Tread – Landing – Number of treads – Width of stairwell (if any) – Drop lines in floor, toilet, kitchen & veranda – Position & size of RWP/ ASP/ SP/ WP/ VP – Overall dimension etc.

SHEET NO. 3 TYPICAL FLOOR PLAN

Showing same as above.

SHEET NO. 4 ROOF PLAN

Showing: *Ghundi* – Ridgeline & Slope line – Position & size of RWP/ ASP/ SP/ WP/ VP – Thickness of parapet wall – Roof projection (if any) – Sectional plan of stair room with its roof projection (if any) – Over Head Tank & ring main etc.

SHEET NOS. 5 & 6 ELEVATIONS (FRONT, REAR & TWO SIDE ELEVATIONS)

Showing: Ground Level – Plinth Level – Floor levels – Roof level – *Mumpty* Room Roof level – Sill & Lintel levels – Height of parapet wall – Roof projection (if any) – Specification of all other non-structural elevational feature.

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SHEET NO. 7 SECTIONAL ELEVATIONS

Two sectional elevations through staircase, kitchen, toilet, front window or veranda / balcony, showing: Ground Level – Plinth Level – Floor levels – Roof level – Entrance to roof – Sill & Lintel levels – Floor slabs at all levels – Flat Brick Soling – Damp Proof Course – Parapet wall – Specification of other structural features (if any).

AR 553 COMPUTER PRACTICE–III

(SESSIONAL SUBJECT)

Full Marks: 100 **Contact Periods: 4S**

Introduction to 3D, Extension, Thickness, Elevation, UCS, 3D Objects, 3D drawing and editing tools – Projects, Introduction to 3D rendering (3DS or equivalent), Material Assignment, Illumination Management – Projects.

AR 571 EDUCATIONAL TOUR & DOCUMENTATION–II

(SESSIONAL SUBJECT)

Full Marks: 50 **Contact Duration: 12 days**

Educational Tour & Documentation – II includes submission of study report on field tour of maximum 12 days' duration conducted by the Department. Classes during the Educational Tour, if held beyond vacations, would remain suspended.

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CE 601 A **STRUCTURAL ENGINEERING – IV**

Semester Examination: **Contact Periods: (2L + 1T)**
Time – 3 hrs. **Internal Assessment:**
Full Marks – 70 **Full marks – 30**

Theory of structures; Wind load, analysis of multi storied frames-portal method; Beams curved in plan; Plastic analysis of structures;

Pre-stressed concrete; Principles, materials, tensioning, methods and devices; Anchorages, pre-tensioning, post-tensioning; Cable profile; Losses in pre-stresses;

Study of IS and other design codes;

AR 601 **CONTEMPORARY ARCHITECTURE–II**

Semester Examination: **Contact Periods: (3L + 1T)**
Time – 3 hrs. **Internal Assessment:**
Full Marks – 70 **Full marks – 30**

GROUP-A COUNTER MOVEMENTS TO MODERNISM

Module 1 FEATURISM

Great increase of synthetic & composite materials from the chemical laboratories leading to a variety of choice of surface materials – Sophisticated richness in surface treatment – Study of the UNITED STATES EMBASSY, NEW DELHI (1955) by EDWARD DURRELL STONE.

Module 2 SCULPTURAL ARCHITECTURE

Exploit of constructional resources beyond traditional geometry – Monolithic structures without or with very few right angles – Study of the (i) NOTRE DAME DU HAUT, RONCHAMP, FRANCE (1954) by CORBUSIER, and, (ii) SOLOMON R. GUGGENHEIM MUSEUM, NEW YORK (1959) by F. L. WRIGHT.

Module 3 BRUTALISM

Concrete exposed at its roughest and handled with over emphasis on big chunky members which collide ruthlessly – Study of the MAISONS JAOUL at NEUILLY-SER-SEINE (1956) by CORBUSIER.

Module 4 TENSILE STRUCTURES

Free fluid monolithic structures – Strength of materials used in tension rather than in compression – Catenary action – Cables with counter-downward-pull to counter the upward pull of suspension cables in addition to the simple action of gravity – Two variations – (i) TWO-DIMENSIONAL TENSILE STRUCTURES: Study of the DULLES INTERNATIONAL AIRPORT, WASHINGTON DC (1962), and, (II) THREE-DIMENSIONAL TENSILE STRUCTURES: Study of the TWA TERMINAL, JOHN F. KENNEDY AIRPORT, NEW YORK (1962) both by EERO SAARINEN.

Module 5 DOMES

Covering large spans uninterrupted by any support structure – Geodesic Domes constructed on the principle of SPACE-FRAME – Tensigrity structures – Study of the: (i) GERMAN PAVILION, EXPO 67, MONTREAL (1967) by FRIE OTTO, and, (ii) US PAVILION, EXPO 67, MONTREAL (1967) by RICHARD BUCKMINISTER FULLER.

Module 6 POST MODERNISM

Pioneer ROBERT VENTURI – THEME: LESS IS BORE – Attacks modernist orthodoxy and elitism of modernist tradition – Urges architecture to come in terms with popular culture – Term formally defined by

CHARLES JENKS referring to a style arising in the early 1970s – Hybrid, doubly-coded, half-Modern and half-conventional – Study of the PORTLAND MUNICIPAL OFFICES, OREGON (1982) by MICHAEL GRAVES – Prominent works of the following post-modernist architects: Robert Venturi, Charles Moore, Michael Graves, Charles Jenks, Mario Botta, Renzo Piano, Richard Rogers, James Stirling.

Module 7 DECONSTRUCTIONISM

Influenced by the writings of philosopher JACQUES DERRIDAS – THEME: FORM FOLLOWS FANTASY coined by BERNHARD TSCHUMI – Apparent fragmentation of building forms – Rejection of the right-angle and curve in favour of the sharp acute angle – General reversal or at least questioning of all principles of design and construction conventionally believed to be axiomatic – Prominent works of the following deconstructionist architects: Peter Eisenman, Bernhard Tschumi, Zaha Hadid, Frank O. Gehry, Daniel Libeskind.

GROUP-B CONTEMPORARY INDIAN ARCHITECTURE

Module 8 MODERN ARCHITECTURE & INDIA

Independent India's Prime Minister Nehru's allegiance to the Western industrial model – Invitation to European & American maters – Study of the (i) CAPITAL COMPLEX BUILDINGS, CHANDIGARH by LE CORBUSIER: THE ASSEMBLY (1960), THE HIGH COURT (1956) & THE SECRETARIAT (1956); and, (ii) INDIAN INSTITUTE OF MANAGEMENT, AHMEDABAD (1974) by LOUIS I KAHN.

Module 9 MAINSTREAM INDIAN ARCHITECTURE

Coming out of the influence of colonial and foreign masters – Assimilation of modernism and late 20th century global architectural trends with the living craft traditions and ritualistic link with heritage – Study of the (i) SANGATH, ARCHITECT'S OWN OFFICE, AHMEDABAD (1980) by BALKRISHNA DOSHI, (ii) ASIAD VILLAGE, NEW DELHI (1982) by RAJ REWAL, and, (iii) KANCHENJUNGA APARTMENTS, BOMBAY (1983) by CHARLES CORREA – Prominent architectural works of the following Indian architects: Habib Rahman, Achyut P. Kanvinde, Laurie Baker, C. P. Kukreja, Charles Correa, Joseph Allen Stein, B. V. Doshi, Hasmukh C. Patel, Raj Rewal, Romi Khosla, Anant D. Raje, Uttam C. Jain, Dulal Mukherjee, Prabir Mitra, and, Hafiz Contractor.

Module 10 ALTERNATIVES FOR A DEVELOPING INDIA

Design and planning as active agents of change in developing nation:

10.1 APPROPRIATE TECHNOLOGY: Alternate building materials & structures – Passive control of built environment – Vernacular building technology & aesthetics – Study of the Centre for Developing Studies, Trivandrum (1975) by Laurie Baker.

10.2 HUMAN SETTLEMENT PROGRAMMES: 'Site-and-Services' scheme – Study of the Aranya Township, Indore (1988) by Balkrishna Doshi – Vastu-Shilpa Foundation, Ahmedabad.

REFERENCE BOOKS

1. A History of Architecture (Century Edition) / Sir Banister Fletcher / Butterworth Heinemann (Hb), CBS Publishers & Distributors (Pb)
2. The Story of Architecture FROM ANTIQUITY TO THE PRESENT / Jan Gympel / Könemann
3. Puzzle of Architecture / Robin Boyd / Melbourne Architectural Press
4. AFTER THE MASTERS Contemporary Indian Architecture / Vikram Bhatt & Peter Scriver / Mapin Publishing Pvt. Ltd., Ahmedabad
5. THE LANGUAGE OF POST-MODERN ARCHITECTURE / Charles Jenks / Academy Editions, London
6. ARCHITECTURE HIGHLIGHTS! / Adams Hubertus and Paul Jochen / DUMONT monte
7. Architecture of Today / Andreas Papadakis & James Steele / TERRAIL
8. AT THE END OF THE CENTURY: ONE HUNDRED YEARS OF ARCHITECTURE / Edited by Russel Ferguson / The Museum of Contemporary Art, Los Angeles, Harry N. Abrams Inc., Publishers

9. CRASH COURSE IN ARCHITECTURE / Eva Howarth / Caxton Editions

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AR 602 MATERIALS & METHODS OF CONSTRUCTION–VI

Semester Examination: **Contact Periods: (3L)**
Time – 3 hrs. **Internal Assessment:**
Full Marks – 70 **Full marks – 30**

Module 1 OPERATION, MAINTENANCE & REPAIR OF BUILDINGS

Introduction — Operation, maintenance and repairs of buildings — Maintenance — Distress of structures & its causes – Defect & decay — Damage: Detection of damage – Removal of damage – Repairs of structures — Classification of maintenance of works — Annual budgetary provision — Determination of approximate age of a building

Module 2 OPERATION, MAINTENANCE & REPAIR OF FOUNDATION

Settlement of foundation & its causes — Repairs to foundation

Module 3 OPERATION, MAINTENANCE & REPAIR OF MASONRY WALLS

Damp walls: Causes & Effects — Remedies & Permanent remedies — Condensation — Efflorescence: Causes, effects & eradication — Cracks in walls & causes of its development – Structural cracks & surface cracks: Investigation, remedial & preventive measures — Precaution while carrying repairs of load bearing walls — Defects in plastering & repair works — Effects of age, weather, environment & temperature and their variation on masonry structure

Module 4 OPERATION, MAINTENANCE & REPAIR OF FLOORS & ROOFS

RCC roofs with lime terracing leaking & its remedial measures — Water proofing compounds – Water proofing white wash – Water proofing solutions – Sylvester process of water proofing the surface — Filling cracks in terraced roof – Repairing hair cracks — Destroying the vegetation with roots in masonry

Module 5 OPERATION, MAINTENANCE & REPAIR OF R.C.C. & STEEL STRUCTURES

Factors affecting durability of concrete & its remedial measures — Maintenance, rehabilitation & repair of concrete structures – Physical examination of common defects & damages – Inspection of the cracks — Repairs in conventional method: Structural repairs and strengthening — Repairs to structures by new development: Chemicals, other new developments — Causes of failure of RCC framed structures — Decay of different parts of stair — Preliminary to maintenance of steel structures: Maintenance procedure – Protective surface coating

Module 6 OPERATION, MAINTENANCE & REPAIR OF TIMBER WORKS

Protection of timber works — Repairs to wooden shutters

Module 7 DILAPIDATION OF BUILDINGS

Building unsafe for habitation — Causes of dilapidation of buildings — Rehabilitation of dilapidated building — Factors influencing the degree of dilapidation of buildings — When a building is to be considered for demolition.

REFERENCE BOOKS

1. Maintenance and Repairs of Buildings / P. K. GUHA / New Central Book Agency (P) Ltd., 8/1 Chintamoni Das Lane, Kolkata – 700 009

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Science University, Shibpur
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2. Building Construction Volume I, II, III & IV (Metric Ed.) / J. K. McKay & W. B. McKay / Orient Longman
3. The Construction of Buildings Volume 1, 2, 3, 4 & 5 / R. Barry / English Language Book Society

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AR 603 **ARCHITECTURAL ACOUSTICS**

Semester Examination:	**Contact Periods: (2L)**
Time – 2 hrs.	**Internal Assessment:**
Full Marks – 35	**Full marks – 15**

Module 1 **NATURE OF SOUND**

SOUND WAVES: wavelength, frequency & velocity – SOUND PRESSURE LEVEL: decibel scale – AUDITORY RANGE: thresholds of hearing & pain – SOUND EFFECTS ON HUMAN – INCIDENCE OF SOUND: reflection, absorption & transmission – NOISE: wanted & unwanted sound – SOUND IN OPEN AIR: effects of wind velocity & temperature gradients, acoustic shadow – SOUND IN ENCLOSED SPACE: air-borne & structure-borne (impact) sound, direct & reverberant components, reverberation time using Sabine's formula (dead & live room), echo, resonance.

Module 2 **ENVIRONMENTAL ACOUSTICS**

NOISE SOURCES: transportation noise, construction noise, industrial noise, leisure noise, ground borne vibration – PLANNING AGAINST NOISE: zoning, distancing & screening, green belts & landscaping, noise barriers – OUTDOOR NOISE REGULATIONS IN INDIA – OPEN-AIR AUDITORIUM

Module 3 **GENERAL BUILDING ACOUSTICS**

ACCEPTABLE INDOOR NOISE LEVELS – TRANSMISSION LOSS: insulation against air-borne sound – SOUND ABSORBENTS: porous absorbents, membrane absorbents, resonant absorbers (Helmholz resonators), perforated panel absorbents — REDUCTION OF NOISE AT OR NEAR SOURCE: noise isolators – CONSTRUCTIONAL MEASURES: wall (hollow & composite wall), floors & ceilings (resilient surface materials, floating floor construction for concrete & wooden floors, suspended ceiling), treatment of skirting, windows & ventilators

Module 4 **RESIDENTIAL BUILDINGS**

SOURCES OF NOISE NUISANCE: outdoor noise, indoor noise – RECOMMENDATIONS: site planning, internal planning, sound insulation

Module 5 **EDUCATIONAL BUILDINGS**

SOURCES OF NOISE NUISANCE: outdoor noise, indoor noise – RECOMMENDATIONS: site planning, internal planning, noise reduction within rooms, sound insulation

Module 6 **AUDITORIA & THEATRES**

SOURCES OF NOISE NUISANCE: outdoor noise, indoor noise – RECOMMENDATIONS: effect of geometry & shape, sitting arrangement, design criteria for different purposes - electro-acoustic installations

REFERENCE BOOKS

1. Manual of Tropical Housing and Building Part 1 Climatic Design / O. H. Koenigsberger, T. G. Ingersoll, A. Mayhew, S. V. Szokolay / Orient Longman

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2. Building Construction / Sushil Kumar / Standards Publishers Distributors, Delhi
3. SP 7 (4): NATIONAL BUILDING CODE OF INDIA 2005 Group 4, Part 8 Building Services, Section 4: Acoustics, Sound Insulation & Noise Control / Bureau of Indian Standards

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AR 604 ESTIMATION & SPECIFICATION OF PROPERTIES

Semester Examination: **Contact Periods: (2L)**
Time – 2 hrs. **Internal Assessment:**
Full Marks – 35 **Full marks – 15**

GROUP - A

Module 1 INTRODUCTION TO ESTIMATING

DEFINITION OF ESTIMATING — PURPOSE OF ESTIMATING — Introduction to IS: 1200 — TYPES OF ESTIMATING: Detailed Estimate – Preliminary or Approximate or Rough Estimate – Quantity Estimate or Quantity Survey – Revised Estimate – Supplementary Estimate – Complete Estimate – Annual Maintenance or Repair Estimate (A. M. or A. R. Estimate) — ABSTRACT OF ESTIMATE

Module 2 INTRODUCTION TO SPECIFICATION

DEFINITION — PURPOSE OF SPECIFICATION — PRINCIPLES OF WRITING SPECIFICATION — TYPES OF SPECIFICATION: GENERAL SPECIFICATIONS & DETAILED SPECIFICATIONS

Module 3 INTRODUCTION TO RATE ANALYSIS

DEFINITION — PURPOSE OF RATE ANALYSIS — FACTORS AFFECTING THE RATE PER UNIT OF AN ITEM

GROUP - B

Module 4 PRINCIPLES OF ESTIMATING

GENERAL ITEMS OF WORK — PRINCIPLE UNITS OF MEASUREMENT FOR VARIOUS ITEMS OF WORK — PRINCIPLE UNITS OF RATE FOR PAYMENT — MODE OF MEASUREMENT for the principle items of works & materials — METHODS FOR ESTIMATING: Long and Short wall method or 'out-to-out' and 'in-to-in' method or PWD method – Centre Line method — Problems

Module 5 APPROXIMATE ESTIMATE

IMPORTANCE OF APPROXIMATE ESTIMATE — PURPOSE OF AN APPROXIMATE ESTIMATE — TYPES OF APPROXIMATE ESTIMATE — PLINTH AREA OR SQUARE-METRE METHOD — ESTIMATED COST OF A PROPOSED BUILDING ON PLINTH AREA BASIS — PROBLEMS

Module 6 SPECIFICATION OF BUILDINGS

6.1 GENERAL SPECIFICATIONS OF A FIRST CLASS AND SECOND CLASS BUILDING

6.2 DETAILED SPECIFICATIONS: EARTHWORK IN EXCAVATION – EARTHWORK IN FILLING – BRICK SOLING – PLAIN CEMENT CONCRETE – REINFORCED CEMENT CONCRETE – DAMP PROOF COURSE – FIRST CLASS BRICKWORK – PATENT STONE FLOORING – TERRAZZO OR MOSAIC FLOORING LAID IN SITU – CEMENT PLASTER SKIRTING – GLAZED TILES IN

SKIRTING AND DADO – WOODWORK FOR DOOR AND WINDOW FRAMES – WOODWORK FOR DOOR AND WINDOW SHUTTERS – CEMENT PLASTERING – CEMENT POINTING – LIME TERRACING – WHITE WASHING – COLOUR WASHING – DISTEMPERING

Module 7 **ESTIMATE OF BUILDINGS**

Detailed quantity estimate of a double storied apartment building including electrical estimation (on point basis) with annual repair and maintenance estimate

G R O U P - C

Module 8 **ESTIMATE OF DOORS& WINDOWS**

Actual consumption of door and window fittings with the mode of measurement — Estimate of a single leaf wooden panelled door with frame — Estimate of a solid core flush door — Estimate of a glazed window shutter

Module 9 **ESTIMATE OF PLUMBING & SANITARY WORKS**

Estimate of: Surface Drain – Household Septic Tanks – Yard Gulley – Master Trap or Inspection Trap or Inspector Manhole or Inspector Chamber – Water Closet – Manhole according to IS:411 – Sewer line – Internal plumbing fixtures

Module 10 **ESTIMATE OF ELECTRICAL WORKS**

Different parts of Electrification – Different systems of wiring commonly adopted for building electrification – Terminologies commonly used – Earthing – Load requirements on plinth area basis – Rating of commonly used electrical installations – illustrative examples

Module 11 **ANALYSIS OF RATE**

Analysis of Rate for: Earthwork – Brick Soling – Concrete Work – Shuttering & Staging – Damp Proof Course – Brickwork – Lime Terracing on RCC roof – Plastering – Pointing – White Wash – Colour Wash

R E F E R E N C E B O O K

1. ESTIMATING, COSTING, SPECIFICATION AND VALUATION IN CIVIL ENGINEERING / M.CHAKRABORTI / M.CHAKRABORTI, 21B, Bhabananda Road, Kolkata – 700 026
2. ESTIMATING & COSTING IN CIVIL ENGINEERING THEORY & PRACTICE INCLUDING SPECIFICATION & VALUATION / B. N. DUTTA / UBSPD

AR 605 **A R C H I T E C T U R A L D E S I G N – I V**

Semester Examination:	**Contact Periods: (1L)**
Time – 12 hrs.	**Internal Assessment:**
Full Marks – 70	**Full marks – 30**

Module 1 **UNDERSTANDING DESIGN PRINCIPLES OF** ASSEMBLY BUILDINGS **BELONGING TO THE** GROUP D-1 & D-2 TYPE OF OCCUPANCY **AS PER THE NATIONAL BUILDING CODE OF INDIA. THIS WOULD INCLUDE ANY BUILDING PRIMARILY MEANT FOR THEATRICAL OR OPERATIC PERFORMANCES AND EXHIBITIONS AND WHICH HAS A RAISED STAGE, PROSCENIUM CURTAIN, FIXED OR PORTABLE SCENERY OR SCENERY LOFT, LIGHTS, MOTION PICTURE BOOTH, MECHANICAL APPLIANCES OR OTHER THEATRICAL ACCESSORIES AND EQUIPMENT, FOR EXAMPLE, PROSCENIUM THEATRES, OPEN AIR THEATRES, AUDITORIA, CINEMA HALLS, CULTURAL COMPLEX ETC.**

Module 2 **UNDERSTANDING DESIGN PRINCIPLES OF** ASSEMBLY BUILDINGS **BELONGING TO THE** GROUP D-5 TYPE OF OCCUPANCY **AS PER THE NATIONAL BUILDING CODE OF INDIA. THIS WOULD INCLUDE ANY BUILDING MEANT FOR OUTDOOR ASSEMBLY OF PEOPLE NOT COVERED BY SUBDIVISIONS D-1 TO D-4, FOR EXAMPLE, GRANDSTANDS, STADIA, OUTDOOR SWIMMING POOLS, AMUSEMENT PARK STRUCTURES, RECREATION PIERS, CIRCUS TENTS ETC.**

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AR 651 A R C H I T E C T U R A L D E S I G N P R A C T I C E – I V

(SESSIONAL SUBJECT)

Full Marks: 250 **Contact Periods: 11S**

Undertaking architectural design of any two topics, one each from the Modules 1 & 2 in sketch-wise phases keeping in mind the provisions regarding "Open Spaces", "Area and Height Limitations", "Off-street Parking Spaces", "Norms for Planting of Shrubs and Trees": —

Module 1 — Assembly Buildings (Group D-1 & D-2 category of occupancy of the NBC): Proscenium Theatres, Open Air Theatres, Auditoria, Cinema Halls, Cultural Complex etc.

Module 2 — Assembly Buildings **(Group D-5 category of occupancy of the NBC): Grandstands, Stadia, Outdoor Swimming Pools, Amusement Park Structures, Recreation Piers, Circus Tents etc.**

The design should be presented through a set of architectural drawings in a suitable scale consisting of at least the following sheets:—

- **(r) site layout showing approach roads to the site, internal road approaching the designed space(s), open parking spaces (if any), planting and landscaping (wherever applicable);**
- **(s) plans showing furniture layout, parking spaces (if any), planting and landscaping (wherever applicable);**
- **(t) elevation(s);**
- **(u) minimum two sectional elevations cutting at least the toilet(s), stairs and any other service area (if any);**
- **(v) models and views in suitable scale.**

One of the designs should be prepared manually and the other with the aid of computer aided drafting.

AR 652 W O R K I N G D R A W I N G – I I

(SESSIONAL SUBJECT)

Full Marks: 100 **Contact Periods: 4S**

Continuation of preparation of a set of working drawings in 1 : 50 scale (unless other wise mentioned), of a G+4 storied apartment building in simple framed structure, started in Group – B of *AR 552 WORKING DRAWING – I*.

SHEET NO. 8 DOOR & WINDOW SCHEDULE

Detail of doors and windows and their schedule to be read along with the different floor plans.

SHEET NO. 9 KITCHEN & TOILET DETAIL

Only plan and section [in 1:25 scale] showing fixture positions and dimensions of fixture, counter, Waste Pipe, Soil Pipe, floor trap, water supply line & slope line.

SHEET NO. 10 ELECTRICAL LAYOUT

Electrical layout showing conduit positions of meter box, distribution box, switch board, light & fans, socket outlets with symbols in conjunction with furniture layout [in 1:50 scale], and, legend of symbols.

SHEET NO. 11 STRUCTURAL DETAILS

Reinforcement details of – (i) column footing, (ii) column, (iii) tie-beam, (iv) floor beam (from support to support) (transverse & cross section), (v) slab; (vi) lintel with *chhajja*, (vii) loft slab, (viii) staircase flight with landing [all in 1:20 scale], and, (ix) slab reinforcement layout [in 1:100 scale].

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Schedules are to be provided showing type, size, reinforcement, binder for – (i) column footing, (ii) tie-beam, (iii) column, (iv) floor beam, (v) slab.

SHEET NO. 12 WATER SUPPLY & SEWERAGE LAYOUT

Ground floor plan [in 1:100 scale] showing plot line, water connection from main to semi under ground reservoir, riser, septic tank, Inspection Chamber, Gully Trap, Yard Gulley – sectional plans & elevations of under ground reservoir, septic tank & over head tank.

SHEET NO. 13 DETAIL DRAWING

Detail drawings of different structural and non-structural features are to be provided like moulding detail, panel detail, dado detail, grill detail, railing detail, handrail detail, Chajja detail, hanger detail, air-conditioning duct detail, false ceiling detail etc., wherever deemed to be necessary.

AR 653 COMPUTER PRACTICE–IV

(SESSIONAL SUBJECT)

Full Marks: 100 **Contact Periods: 4S**

Introduction to LISP, Simple Programming, Projects, 3D rendering, Advanced Modelling (Maya or equivalent), Introduction to animation, Advanced CAD application, Projects.

AR 654 ESTIMATION PRACTICE

(SESSIONAL SUBJECT)

Full Marks: 50 **Contact Periods: 3S**

Detailed quantity estimate of a double storied apartment building including sanitary works and electrical estimation (on point basis) with annual repair and maintenance estimate is to be carried out. The principles and different methods of estimating, the knowledge regarding the general specifications of first & second classes of buildings and detailed specifications of some common items of work, and, the concept of analysis of rate, as understood in the subject *AR 604 ESTIMATING & SPECIFICATION OF BUILDINGS* are to be applied in undertaking the estimating practice. (The double storied apartment building may have been designed by the students in their earlier semesters or the necessary drawings may be provided by the concerned faculty-in-charge.)

REFERENCE BOOK

1. ESTIMATING, COSTING, SPECIFICATION AND VALUATION IN CIVIL ENGINEERING / M.CHAKRABORTI / M.CHAKRABORTI, 21B, Bhabananda Road, Kolkata – 700 026
2. ESTIMATING & COSTING IN CIVIL ENGINEERING THEORY & PRACTICE INCLUDING SPECIFICATION & VALUATION / B. N. DUTTA / UBSPD

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DEPARTMENT OF CIVIL ENGINEERING

APPROVED SYLLABUS for UNDERGRADUATE (B.E.) COURSE

1st & 2nd semester B.E.. Courses

CE 101 ENVIRONMENT AND ECOLOGY **(for all Engg. Branches)**

SEMESTER EXAMINATION:	**CONTRACT PERIODS: (2 L + 0T)**
TIME – 2Hrs.	**Continious Assessment :**
Full Marks -35	**Full Marks -15**

Introduction:
Components of environment, renewable and non-renewable resources.

Ecology:
Structure and function of an ecosystem; material cycle; energy flow; food chain; food web; ecological pyramid; biomagnification; ecological succession; major ecosystems of the earth; ecological balance and consequences of change; biodiversity and its conservation.

Water Pollution:

Surface water and ground water; water pollutants- sources and effects; agricultural pollution; eutrophication; case studies; water quality standards; control of pollution.

Air Pollution:
Atmospheric composition; energy balance; air pollutants- sources and effects; weather and dispersion; vehicular pollution; case studies; air quality standards; control measures; global atmospheric issues – global warming, ozone layer depletion, acid rain, indoor air pollution.

Land Pollution:
Municipal, Industrial, Commercial, agriculture, hazardous solid wastes; collection and disposal; recovery and conversion; case studies.

Noise Pollution:
Classification of noise; the decibel; frequency characterization; noise criteria (L_{eq} L_N); standards; control measures.

Other Environmental issues:
Form unsustainable to sustainable development; environmental impact assessment, environmental impacts of urbanization; environmental impacts of selected industrial activities; clean technologies; waste minimization; water conservation; rain water harvesting; watershed management; environment protection Act; Water (Prevention and control of pollution) Act; Air (Prevention and Control of pollution) Act,relevant international protocols and conventions; ISO 14000.

CE 201A ENVIRONMENT AND ECOLOGY (for Architecture)

SEMESTER EXAMINATION:	**CONTRACT PERIODS: (2 L + 0T)**
TIME – 2Hrs.	**Continious Assessment :**
Full Marks -35	**Full Marks -15**

Introduction:
Components of environment, renewable and non-renewable resources.

Ecology:
Structure and function of an ecosystem; material cycle; energy flow; food chain; food web; ecological pyramid; biomagnification; ecological succession; major ecosystems of the earth; ecological balance and consequences of change; biodiversity and its conservation.

Water Pollution:
Surface water and ground water; water pollutants- sources and effects; agricultural pollution; eutrophication; case studies; water quality standards; control of pollution.

Air Pollution:
Atmospheric composition; energy balance; air pollutants- sources and effects; weather and dispersion; vehicular pollution; case studies; air quality standards; control measures; global atmospheric issues – global warming, ozone layer depletion, acid rain, indoor air pollution.

Land Pollution:

Municipal, Industrial, Commercial, agriculture, hazardous solid wastes; collection and disposal; recovery and conversion; case studies.

Noise Pollution:
Classification of noise; the decibel; frequency characterization; noise criteria (L_{eq} L_N); standards; control measures.

Other Environmental issues:
Form unsustainable to sustainable development; environmental impact assessment, environmental impacts of urbanization; environmental impacts of selected industrial activities; clean technologies; waste minimization; water conservation; rain water harvesting; watershed management; environment protection Act; Water (Prevention and control of pollution) Act; Air (Prevention and Control of pollution) Act,relevant international protocols and conventions; ISO 14000.

Third Semester

CE 301: Surveying I Full Marks- 100

3 - 1 – 0

Introduction, ;Types of Surveys, Chaining, Taping, Corrections, Angle and Direction Measurements, Prismatic compass, Measurement of bearing, Computations of angles from bearings, Theodolite Surveying, Temporary Adjustments, Traversing, Principle of Leveling, Simple and Differential Leveling, Adjustments, Plane table Surveying, Different Methods, Two and Three Point Problems, Minor Surveying Instruments, Setting out Simple Works.

CE 302: Engineering Materials, Construction & Services F.M.-100

3 – 0 – 0

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Materials : Stone, brick, timber, lime, tar, bitumen, steel, asbestos, cement, concrete and plastic composites, glass fibre, ferrocement, epoxy and different alternatives materials like Industrial slags, cinder, Fly ash etc.

Chemical and physical properties of different metals and alloys-CI, Tor steel.

Construction : Construction of buildings : Brick and stone masonry, various types of foundations; floor systems & roofs; floor finishes; staircase and lift; finishes in walls- painting; plastering etc.; lintels and arches, timber partition walls; doors and windows; damp proofing and termite control.

Acoustics : Criteria and terminology; acoustics auditorium, class room etc.

Air conditioning and ventilation in industrial houses and public buildings.

Fire fighter arrangements in house in high rise buildings.

Service : Water supply plumbing in buildings. Water supply in high rise buildings, Hot water supply.

Refuge disposal from individual house high rise buildings.

CE 351: Civil Engineering Drawing Full Marks- 100

0 – 0 – 6

Building component- staircase; foundation; Site and building planning- Site plans, simple one-bedroom house, two-storied house, multi-storied building; Drawing and detailing for simple steel structures and Bridges.

CE 301 A S T R U C T U R A L E N G I N E E R I N G – I

Semester Examination:	**Contact Periods: (2L + 1T)**
Time – 3 hrs.	**Internal Assessment:**
Full Marks – 70	**Full marks – 30**

Theory of structures; Review of stresses on beams; Composite beams; Deflection in beams; Determinate and Indeterminate beams;

Energy methods and their applications in beam problems; Theory of columns; Short and long columns; Empirical formulae;

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CE 302 A **S U R V E Y I N G**

Semester Examination: **Contact Periods: (2L)**
Time – 2 hrs. **Internal Assessment:**
Full Marks – 35 **Full marks – 15**

Chain surveying; Principles, Methods of linear measurement; Instruments for Chaining; Chaining over uneven ground; Chaining tape corrections including sag corrections; Chain triangulation; Selection of stations, locating ground features; Plotting of chain survey' determination of area by chain survey, setting out of a building.

Compass survey; Use of prismatic compass; Chain and Compass traversing, Plotting compass traverse;

Plane table survey; Introduction and method; Errors in plane tabling;

Leveling; Adjustment of dumpy level; Reciprocal leveling and profile leveling; Countering and interpolation of contour maps;

Fourth semester

CE 401: **Structural Analysis – I** **Full Marks- 100**

3 - 2 – 0

Stability and Determinacy of Structures, Analysis of Statically Determinate Structures, Review of shear force and bending moment diagrams in beams and frames, Plane trusses: Deflection of trusses: Deflection of beams and frames: Influence line diagrams and moving loads, Introduction to Statically Indeterminate Structures, Introduction to moment distribution method.

CE 402: **Surveying II** **Full Marks- 100**

3 - 1 – 0

Introduction, Field Astronomy- Astronomical coordinate sysdtem, corrections on attitude of celestial bodies, azimuth determination, determination of latitude by meridian and ex-meridian observations, elongation of circumpolar stars, longitude and times; Horizontal Distance Measurements - Electronic

Distance Measurement (EDM), Theodolite - Triangulation Measurements, Traverse Survey and Computations, Total Station Instrument, Vertical Distance Measurement, Trigonometric Levelling, Contouring, Stadia Tacheometry, Different Types of Tacheomatric Measurements, Introduction to Photogrammetric Surveying & Mapping, Remote Sensing and Mapping, Aquaintance with Global Positioning System, Application of Surveying to Practical Problems.

CE 403: Concrete Technology Full Marks- 100

3 – 1 – 0

Types of cement – their properties and testing. Aggregates – properties and testing. Admixtures and additives. Properties of concrete – fresh and hardened. Elasticity, shrinkage, creep and durability of concrete. Special type of concrete – lightweight concrete, polymer concrete, fibre reinforced concrete etc.

CE 404: Planning, Estimating & Valuation Full Marks- 100

3 – 1 – 0

Planning : Principles of building planning; regulations and bye-laws of the sanctioning authorities.

Estimating : Principals of estimating, types of estimating, measurements and calculation of quantities of Civil engineering works. Bill of quantities and abstract of cost. Rate analysis of different items of works. Use of standard schedules such as PWD schedules of rates. Specifications.

Valuation : Concept of price, value and cost. Purpose of valuation; free hold and lease hold properties; market value, present value; sinking fund; year's purchase. Different methods of land valuation. Different methods of valuation of real properties. Outgoing, appreciation, depreciation-different methods. Fixation of rents. Valuation of plant and machineries.

CE 451: Planning, Drawing & Estimation Full Marks- 50

0 – 0 – 3

Planning of buildings as per Municipal Regulations- Drawing plans and sections; Drawing of details for R.C.C. buildings with Bar Bending Schedules; Estimation of different items of works. Drawing of details for simple steel structures with complete estimation of different items of work from material as per bill of quantities to final painting.

CE 471: Surveying Practical Full Marks- 50

0 – 0 – 3

Sessional work based on Surveying- I

CE 401 A **S T R U C T U R A L   E N G I N E E R I N G – I I**

Semester Examination:	**Contact Periods: (2L + 1T)**
Time – 3 hrs.	**Internal Assessment:**
Full Marks – 70	**Full marks – 30**

Steel structures; Permissible stresses; Design of truss members; Simple riveted and welded connections including beam-end connections;

Built-up beams and columns; Design of base-plate, gasset plate and concrete footings for steel columns; Grillage foundation;

Reinforced concrete; Permissible stresses, Rectangular, T and L beams; Double reinforced beams; One way slab; Columns and isolated footings; Design of lintels and Chajjas; Cantilever beams; Distribution of base pressure; Middle third rules; earth pressure; Design of simple retaining wall; Cantilever retaining wall.

CE 471 A **S U R V E Y   P R A C T I C E**

(Sessional Subject)

Full Marks: 200 **Contact Duration: 10 days**

Surveying practical includes demonstration on field on the topics under the purview of the subject – SURVEYING – CE 302(A). The demonstration and practical shall be of 10 days' duration to be conducted by the Department of Civil Engineering at the beginning of the semester.

Fifth Semester

CE 501: **Design of R.C. Structures** **Full Marks – 100**

3 – 0 – 0

Introduction to the design of Concrete structures Working stress and Limit state methods; Design of beams for flexure, bond, shea; Axially and eccentrically loaded Columns; Footings: isolated and combined , One and two-way Slabs, Stair cases.

CE 502: Soil Mechanics - I Full Marks – 100

3 – 1– 0

Introduction – Origin of Soils, formation, composition, types, structure. Physical properties of soils, soil phases, weight-volume relationship. Index properties – Atterberg's limits, relative density, identification and classification of soils.

Water in Soils – gravitational water, capillary moisture, adsorbed water, effective pressure, porewater pressures etc., critical hydraulic gradient, quick sand condition. Permeability in Uniform and Stratified deposit – Laboratory and field determination. Seepage through soils – continuity equation, construction of flownets, properties and uses of flownets, flow through earthen dam, estimation of quantity of seepage.

Stresses in soils for concentrated load, line load and distributed loads over limited areas of different shapes- Boussinesq's and Westergaard's theory, Newmark's chart. Pressure bulbs, isobars. Mohr circle, concept of stress path.

Sheer strength of soils – Coulomb's equation, Mohr – Coulomb's equation, Mohr – Coulomb failure criteria, pole, Methods of determining shear strength parameters – laboratory and field tests, drainage conditions, pore pressure parameters.

Compressibility and consolidation – normally consolidated and over consolidated soils, compression and swelling indices, preload, one dimensional consolidation. Determination of coefficient of Consolidation, Time factor, Settlement Computation.

CE 503: Water Resources Engineering Full Marks – 100

3 – 2 – 0

Catchment and its physical characteristics; Hydrologic cycle; Hydrologic Budget; Precipitation Types and forms: conditions necessary for precipitation; Measurement of point rainfall – rain gauges;

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Estimation of missing rainfall data, checking of consistency, optimum number of raingauges; Average rainfall over an area – different methods; Rainfall mass curve, hyetograph, Frequency analysis of rainfall, Intensity duration curve, Evaporation, evapotranspiration and infiltration - the processes, measurement and estimation.

Runoff components: factors affecting runoff, estimation of runoff, rainfall-runoff correlation.

Stream flow measurement – different direct and indirect methods; stage discharge curve; Unsteady flow and backwater effects.

Hydrographs: Unit hydrograph – Assumptions, Derivation, Applications and limitations, S-curve, Synthetic and Instantaneous unit hydrograph, Distribution graph.

Statistical Preliminaries: Statistical Terminology, Probability of Discrete and Continuous Random Variables, Method of moments, Distribution Functions, Reliability of Estimates of Distribution characteristics, Frequency Distributions.

Ground water hydrology: Aquifers, Well hydraulics, Tube wells, Salt water intrusion, Artificial recharge.

CE504 Environmental Engineering - I

3 – 2 – 0

General: Environment and its components, Importance of water, Role of an environmental engineer, Historical overview.

Water Demand: Design flow Design periods, Design population, Factors affecting water consumption, variations in water demand, Design capacities for various water supply components.
Source of water and Collection Works: Alternative sources i.e. rain, surfeace and ground water, Assessment of yield and development of sources.
Quality of water: The hydrological cycle and water quality, physical, chemical and biological water quality parameters, water quality requirements, Indian Standards.
Transmission of Water: Hydraulic of conduits, Selection of pipe materials, materials and joints, pumps, pump stations.
Treatment of Water: Historical overview of water treatment., Water treatment prepossess(theory and application): Aeration, solids separation, settling operation ,coagulation softening, filtration,

disinfection,other treatment process: Dissolved solid removal, treatment plant design ,preparation of hydraulic design.
Distribution of water: Methods of distributing water, Distribution reservoirs, Distribution systems, distribution system components. Capacity and pressure requirements, Design of distribution systems, Hydraulic analysis of distribution system, Pumping requirement for water supply systems.

General: Sewerage, Domestic sewage, sewage treatment, disposal, scope, role of environmental engineer, historical review.

Sewage Characteristics: Quality parameters: BOD, COD, TOC, Solids, DO, Nitrogen, Phosphorus, Standards of disposal into natural water courses and on land, Indian standards**.**
Collection of Sewage

Systems of sewerage: Separate, combined and partially separate, components of sewerage systems, systems of layouts, quantity of sewerage system and variation quantity of storm water, rational method, shape of sewer, circular and egg shape, Hydraulic design of sewers, diameter, self cleansing velocity and slope, Construction and testing of sewer lines, Sewer materials, joints, and appurtenances, Sewage pumping stations, Maintenance of sewerage system.

Sewerage Treatment
Various units: and their purposes sequence and efficiencies, preliminary treatment: Screening and grit removal units, oil and grease removal, primary treatment, secondary treatment, activated sludge process, trickling filters, Sludge digestion and drying beds, Stabilization ponds, Septic tank, Soakage systems, Imhoff tank, Recent trends in sewage treatment, Advanced waste water treatment: Nutrient removal, Solid removal.

Waste water disposal and Reuse
Disposal of sewage by dilution, self-purification of streams, Sewage disposal by irrigation and sewage farming, wastewater reuse

CE 505: Transportation Engineering Full Marks – 100

3 – 2 – 0

Introduction to Transportation and Transportation Engineering

Forms and Modes of Transportation and their Characteristics

Highway Engineering: History of Road Transportation in India, Functional classification of roads; Road Planning & Route Survey – Horizontal & Vertical alignment ; Cross Sectional Elements; Geometric Design of Roads; Pavement Structure and Materials – Subgrade soil, Subbase and Base Materials, aggregates & Bitumen, Pavement Design– Flexible and Rigid by IRC and other methods; Construction of Roads – Embankment, Subgrade, Subbase, Base and Bituminous layers, Cement Concrete Pavements; Quality control tests; Road Drainage; Road Maintenance; Elements of Hill Roads.

Cross Drainage Structures: Bridges & Culverts

Port & Harbour Engineering; planning layout of port, dock, harbour & jetties; Different components of port harbour; Design of Breakwater

CE 551: Concrete Technology Lab. Full Marks – 50

0 – 0 – 3
Laboratory work based on the subject concrete technology

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CE 552: Project – I Full Marks – 200

0 – 0 – 6

Sessional Work based on Design of R. C. Structure CE 501

CE 571: Surveying Practical Full Marks- 50

0 – 0 – 0

Sessional work based on Surveying-II for 2-weeks duration at a stretch when other classes will remain suspended.

Sixth Semester

CE 601: Design of Steel Structures Full Marks – 100

3 – 1 – 0

Introduction to Design: Design Loads and Load Combinations Working Stress design, Plastic Design, LRFD Methods, Introduction to Steel and Steel structures, Design of tension members, Design of structural fasteners: rivets, bolts and welds, Design of compression members, Design of flexure members: Beams - rolled sections, built-up sections, Plate Girders – riveted/bolted and welded, Design of eccentric connections: riveted/bolted and welded, Design of beam-columns joints and column bases, Design of steel industrial sheds, Wind Design, Introduction to inelastic actions and plastic hinges: application of PD and LRFD.

CE 602: Structural Analysis II Full Marks – 100

3 – 2 – 0

Application of slope deflection, moment distribution and energy methods to frame structures, redundant frames and trusses, ring, box culvert, two hinged and fixed arches. Concepts of Column Analogy, Müller Breslau Principle, Influence line for indeterminate structures, Analysis of suspension bridge, two hinged arch. Matrix structural analysis: Concept of displacement and force methods, Application of displacement methods to truss, beam and frames structures.

CE 603 : Soil Mechanics – II Full Marks – 100

3 – 2 - 0

Stability of slopes – types of failure, Swedish Circle method, method of slices, stability number, factor of safety, remedial measures.

Soil stabilization – Compaction, Laboratory test, field methods, Uses of admixtures, Principles of Reinforced earth.

Soil exploration – methods of boring, sampling, Soundings – Standard penetration test, Static cane penetration test, Dynamic cane penetration test, Spacing, depth and number of exploratory borings. Indirect methods of soil exploration – Seismic refraction method and electrical resistivity method.

Earth pressure theories – Rankine and Coulomb, Different types of back fill. Analytical and graphical methods for determination of earth pressure against various earth retaining structures. Stability of retaining walls – cantilever and counterfort type. Sheet piles.

Cofferdams – Uses, common types.
Excavation and bracings.

CE 604 Irrigation and Hydraulic Structures Full Marks – 100

3 – 1 - 0

Irrigation: Necessity, Types, Techniques, Quality of Irrigation water, Soil-water-plant relationship, Water requirement of crops, Base period, Duty, Delta, Commanded area, Intensity of irrigation, Consumptive use of water, other terms related to water requirement of crops, Irrigation efficiencies, Irrigation requirement of crops, Frequency of irrigation.

Water Storage: Flow mass curve, estimation of storage required for irrigation and other demands.

Canal irrigation: Classification of canals, canals in alluvium, design of unlined canals: Kennedy's method, Lacey's method, lined canals: advantages, materials used, typical sections, design of lined canals, economics of canal lining.

Diversion headworks: Necessity and uses, different types, Layout and different components, weirs on permeable foundation, Creep theories, Khosla's method, different types of modules, canal escapes.

Groundwater: Aquifer, well hydraulics, specific yield, specific retention, storage coefficient, Darcy's law, steady flow in a well, yield.

Drainage: Waterlogging: causes and ill effects, drainage: hydraulics and design of drains.

CE 605 : Environmental Engineering II Full Marks – 100

3 – 1 - 0

Air Pollution and Control:

General : Definitions

Type of Air Pollutants and Sources : Particulates, CO, SO2, NOX, Hydrocarbons, Natural and man made sources Emission factors, Air pollution due to Industries and Automobile Exhausts, **Air Quality and Emission Standards**

Effects of air pollution : Plant Damage, Corrosion, Art treasures, Human health-respiration System, Special disesase, Episodes

Meteorology : Wind Profiles, Turbulent Diffusion, Wind Roses, Topographical Effects, Inversion, Plume behavior, Plume rise, and Stable conditions

Plume dispersion : Gaussian Model, Diffusion coefficients Inversion Effects, Limits to the model

Particulates : Terminology, Size distribution, removal mechanism, particulate collection devices, Choice of equipments

Sulphur Oxides : SO_x, Sources, Ambient concentrations, Standards, Test methods, Control techniques

Nitrogen Oxides : NO_X, Sources, Ambient concentrations, Standards, Test methods, Thermodynamics & kinetics of nitrogen oxides, Control techniques

Global effects of Air-Pollution : Green house effect, Acid rain, Ozone layer disruption.

Solid waste Management :

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Municipal Solid Waste : Generation, Rate Variation, characteristics (Physical, Biological and Chemical); Management Options for Solid Waste, Waste Reduction at the Source, Collection techniques, Materials and Resources Recovery / Recycling. Transport of Municipal Solid Waste, Treatment, Transformations and Disposal Techniques (Composting, Vermi-Composting, Incineration, Refuse Derived fuels, Landfilling). Norms, Rules and Regulations. Economics of the on-site v/s off site waste management options. Integrated waste management.

Noise Pollution :

Definitions; noise levels and noise measurement; standards; continuous, intermittent and impulsive noise; noise criteria; noise propagation; noise control

CE606 Transportation Engineering –II Full Marks – 100

3 – 1 - 0

Traffic Engineering: Road user and vehicle characteristics ; Traffic flow characteristics– Traffic Volume, Speed, Headway, Concentration, and Delay; Traffic surveys & studies; Traffic estimation; Statistical applications in traffic engineering analysis; Parking; Road intersections – Basic traffic conflicts, classification of at-grade intersections, channelization, rotaries, traffic signals, signs, and marking; Road Safety; Traffic System Management.

Transportation Planning: Transportation planning at different levels; Transport Project planning – Planning studies and investigation; Elements of Urban Transportation Planning; Transport Demand Analysis; Preparation of Project Report.

Railway Engineering: Location surveys & alignment; Permanent way components, Gauges, Geometric Design, Points & crossings; Stations & Yards, Signalling, Track Maintenance.

Airport Engineering: Functional areas of airports – Runways, Taxiways, Aprons, Terminal buildings; Classifications of Airports; Airport site selection; Design of Runway, Runway orientation, Wind Rose diagram; Design of Taxiway and Terminal Building.

CE 651: Structural Engineering Laboratory Full Marks – 50

0 – 0 – 3

CE652: Project – II Full Marks – 200

0 – 0 – 6

Sessional Work based on Design of Steel Structures CE 601

CE671: Viva Voce – I Full Marks – 100

0 – 0 – 0

Seventh Semester

CE 701: Structural Engineering - III Full Marks – 100

3 – 0 – 0

Analysis of stresses and strains, Equilibrium and compatibility conditions, Formulation of boundary value problems of elasticity, Generalized plane stress and plane strain relations, St. Venant's principle; Introduction to the analysis of simple problems of plates and shells.
Concepts of dynamics and Vibrations; SDOF system with damped and undamped conditions; Concept of discrete Multidegree of Freedom systems and continuous systems, Impulse and Earthquake response; Concept of Earthquake response spectra.

CE 702: Foundation Engineering Full Marks – 100

3 – 1 – 0

Bearing capacity of soils – Definition, factors affecting bearing capacity, modes of failures. Methods of determining bearing capacity of soils. Allowable bearing pressure and settlement analysis. Field tests. Effect of water table and ecoentric loads. Improvement of bearing capacity.

Shallow foundations – Allowable bearing pressure and permissible settlements. Types of footing – Isolated, combined, strip, grid and raft foundations. Isolated footings with combined action of loads and moments.

Deep foundations – Types of piles, material, suitability and uses. Determination of types and lengths of piles, pile capacity, pile spacing and group action. Stress in lower strata, settlement analysis. Design of pile caps. Negative skin friction, testing of piles. Caissons – use, type, size and analysis.
Drainage and dewatering.

Machine foundations.

CE 703: Disaster Mitigation Full Marks – 100

3 – 0 – 0

Concepts of disaster; Types of disaster – natural and manmade : Cyclone, flood, land slide, land subsidence, fire and earthquake. Issues and concern for various causes of disasters.

Disaster management, mitigation, and preparedness; Techniques of monitoring and design against the disasters.

Management issues related to disaster; Mitigation through capacity building, legislative responsibilities of disaster management; disaster mapping, assessment, pre-disaster risk & vulnerability reduction, post disaster recovery & rehabilitation; disaster related infrastructure development.

Remote-sensing and GIS applications in real time disaster monitoring, prevention and rehabilitation.

CE704: Introduction to Remote Sensing and GIS Full Marks – 50

2 – 0 – 0

Remote Sensing: Introduction, Historical Perspective, Uses, Basic Principles, Types, Platforms and Satellites, Sensors, Spectral Bands, Spectral reflectance curves.

Satellite Image Processing: Pre-Processing, Corrections and Rectification of images.

Geoprocessing: Map projections, Coordinate system, Map Transforming Models and processes.

Information Extraction: Thematic Information Extraction, Classification techniques, Supervised Classification, Unsupervised Classification.

Geographic Information Systems: Introduction, Data, Information Systems and Planning, GIS subsystems.

Spatial Analysis:- **Spatial Elements, point, line, area, surface, Scale, Spatial data, Aspatial data, Discrete and continuous data Measurement scales - nominal, ordinal, interval and ratio, Reference systems.**

Spatial Data Structures: Graphic representation of spatial data, Raster data structure, Vector data structure, Comparison of Raster and Vector structure

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Data Analysis and Modeling –Spatial measurement methods, Buffering techniques, Overlay analysis, GIS output

Applications in Civil Engineering: Natural disaster mapping and monitoring, Irrigation Planning, Transportation Planning etc.

CE705: Advanced Structural Design Full Marks – 100

3 – 0 – 0

Flat Slabs, Ribbed slabs; Raft and pile foundations; Beams Curved in Plan, Water Tanks and Retaining Walls; introduction to design of masonry structures. Design of prestressed concrete structures Steel towers, Bunkers and silos. Pressure vessels and chimneys. Cooling towers. Structural aspects of machine foundations.

CE 751: Soil Mechanics Laboratory Full Marks – 50

0 – 0 – 3

Identification and Physical description; Specific gravity; Mechanical analysis; Proctor's Compaction test; C B R tests, Permeability – Constant head, Variable head; Direct Shear test – Cohesionless soil, Cohesive soil; Unconfined Compression test; Triaxial test – Undrained, Drained; Triaxial test with pore pressure measurements; Consolidation test, Vane Shear test.

CE752: Water Resources Engineering Lab Full Marks – 50

0 – 0 – 3

Tests and Problems

CE 753: Remote Sensing and GIS Sessional Full Marks – 50

0 – 0 – 2

Practices based on the course Remote sensing and GIS .

CE 754: Environmental Engineering Laboratory Full Marks – 50

0 – 0 – 3

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CE 755: Transportation Engineering Laboratory Full Marks – 50
0 – 0 – 3

Quality Control tests for Pavement aggregates and bitumen; Bituminous Mix Design; Pavement evaluation and roughness measurement; Traffic Surveys, Analysis of Traffic Data.

CE 756: Project – III Full Marks – 150

0 – 0 – 6
Sessional Work based on Advanced Structural Design CE 705

CE 771: Seminar Full Marks – 50
0 – 0 – 0

Eighth Semester

CE 801 : Construction Technology Full Marks – 100

3 – 1 – 0

Steel work	:	Steel work fabrication / erection
		Fasteners
		Quality Control & Assurance
Concrete	:	Concrete making / Transporting / pouring / curing.
		Formwork and scaffolding
		Quality Control & Assurance.
Special Structures	:	Foundations – types and problems

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		Bridges & Aqueducts Towers, Chimneys, Highrise Buildings Dams, Embankments Containment structures Marine / Offshore structures Dams / Embankments Tunneling.
Equipment	:	Types, capacity Equipment planning Maximizing output Maintenance Mech, Elect, HIVAC elements
Protection	:	Protection.
Maintenance	:	Maintenance Repairs / Restoration.

CE 802: Project Planning & Management Full Marks – 100

3 – 1 – 0

Project	:	Project Conception Feasibility Cost-Benefit Analysis Project Appraisal
Planning	:	Staff, Labour, Materials Logistics Progress Planning
Management	:	Network methods Resource management – matis/men/mach/money Progress Planning Inventory Control Management Information Systems.
Contacts	:	General conditions – types/bias. Special conditions

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		Specifications Measurement Payment types / conditions.
Tendering	:	Prequalification criteria Tender documents Tender evaluation Tender negotiation Tender pricing strategies.
Construction Finance	:	Financial planning Costing Time & Cost over-runs Claims & Settlement Insurance.
Personnel	:	Personnel management Staff & Labour welfare Public relations.
Safety	:	Site safety measures Accident prevention First aid.
Laws	:	Labour laws Arbitration laws.

Elective I

CE803/1: Advanced Structural Design Full Marks – 100

3 – 0 – 0

Design of prestressed concrete structures: design of simple bridges and liquid retaining structures; introduction to design of masonry structures. Industrial buildings, steel towers, Bunkers and silos. Pressure vessels and chimneys. Cooling towers. Large span roof structures. Suspension roof structures. Structural aspects of machine foundations.

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CE803/2: Earthquake Engineering Full Marks – 100

3 – 0 – 0

Causes of earthquakes and seismic waves, Magnitude, intensity and energy release, Characteristics of earthquakes, Seismic risk; EQ response of structures, Single-degree-of freedom dynamics, Concept of response spectra and introduction to multi-degree-of-freedom systems; Design response spectrum, Idealization of structures, Response spectrum analysis, Equivalent lateral Force concepts; Philosophy of earthquake resistant design, Ductility, Redundancy & overstrength, Damping, Supplemented damping, Base Isolation, Code provisions; Seismic behaviour of concrete, steel and masonary structures, Material properties, Behaviour and analysis of members under cyclic loads, Seismic detailing provisions, Review of damage in past earthquakes.

CE803/3: Experimental Methods of Structural Analysis

Full Marks – 100

3 – 0 – 0

Introduction: theories of similarities, dimensional analysis. Model and analogies – classification and equivaience. Design of models. distorted models. ultimate strength models. Mechanical, electrical, optical and acoustic methods of measurement of static and dynamic quantities. Transducers, photoelasticity and photoelastic coating techniques. Brittle lacquer and moiré method. Non-destructive testing. In-situtests. short term and long term methods.

CE803/4: Reliability-based Analysis and Design Full Marks – 100

3 – 0 – 0

Basic concept of reliability- Definition, need of reliability analysis, measure of reliability, Fundamentals of structural reliability analysis, modelling of load, resistance
Structural reliability analysis- Risk and safety factor concept, partial safety factor method, safety index, various first order and second order reliability analysis method, reliability with correlated variables, reliability analysis for non Gaussian variables and related transformation. Reliability based design. Response surface method, MCS. Introduction to component and System reliability concepts.

CE803/5: Applications of Finite Element Methods Full Marks – 100

3 – 0 – 0

Background material; discussions of engineering problems to demonstrate the versatility of FEM; limitations of FEM; modeling of problems; analysis using finite element computer codes; applications.

CE803/6: Civil Engineering Materials Full Marks – 100

3 – 0 – 0

Cement selection for civil works. Concrete making materials. Fresh concret and its rheology mechanical, deformational behavior and microstructure of hardened concrete. Creep and shrinkage. Laboratory testing of concrete. Durability of plain and reinforced concrete, Structural steels including alloyed and cold - worked steels. Industrial waste materials in concrete, their influence on physical and mechanical properties and durability of concrete, Concrete at high temperature. High strength concrete. Changes in concrete with time, Corrosion of concrete in various environments. Corrosion of reinforcing steel. Electro-chemical process, measures of protection. Ferro-cement, material and properties. Foams and light weight materials, fibrereinforced concrete.

CE 803/7: Geotechnical Investigation and Practices Full Marks – 100

3 – 0 – 0

Methods of Geophysical exploration – seismic refraction and electrical resistiving methods. Field soil exploration – planning and exploration programme. Methods of boring, sampling – samplers. Spacing, number, extent and location of bore holes. Bore logs. Stabilization of bore holes.

Insitu method of determination of different soil properties like shear strength, permeability etc. Soundings, pressure meter. Determination of water table. Under water exploration. Technique of ground water exploration.

Exploration methods in rocks – investigation, sequence, drilling, sampling and bore hole inspection. Stresses in rocks, and properties of rocks.

Laboratory methods for determining the various properties and behaviour of soils. Dynamic testing of soils.
Methods of geotechnical study for various civil engineering design and construction.

Preparation of necessary report
Instrumentation.

CE 803/8: Geotechnical Earthquake Engineering Full Marks – 100

3 – 0 – 0

Introduction, Seismic Risks and seismic hazards, cause and strength of earthquake, social and economic consequences, theory of dynamics and seismic response, the nature and attenuation of ground motion. Determination of site characteristics, local geology and soil condition, site investigation and soil test. Determination of design earthquake, response spectra and accelerograms as design earthquake, criteria for earthquake resistant design. Site response to earthquake, liquefaction of saturated cohesionless soils, seismic response of soil structure system, shallow foundation, pile foundation, foundation in liquefiable ground. A seismic design of earth retaining structures.

CE 803/9: Ground Improvement Full Marks – 100

3 – 0 – 0

Introduction, Economic considerations, Consolidation by preloading and sand drains; strengthening by granular columns, Stone columns; lime columns; Compaction by vibrofloatation, blasting and dynamic consolidation; Improvement of deep strata of fine soils by vacuum dewatering, electroosmosis, ground freezing and thermal stabilization; Grouting techniques and principles. Reinforced earth and applications of geosynthetics; retaining walls, slopes, roads, erosion. Ground anchors and soil nailing; Problems and

CE803/10: Water Resources System Full Marks – 100

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3 – 0 – 0

Scope and approach of Water Resources System Engineering, Water system dynamics, Objectives and evaluation criteria, System elements and subsystem Planning, Large scale system analysis, Application of system analysis to water resources systems.

CE 803/11 Industrial Waste Treatment Full Marks – 100

3 – 0 – 0

General
Effect of discharge of industrial wastewaters on streams, land and enviromrmet, importance and scope, problem involved in water treatment, Variation and quality of industrial wastewater.
Standard and Criteria
Indian Standards for discharge of treated wastewaters on land, into municipal sewer and natural watercourses**.**
Sampling of wastewaters
Representative samples, Grab and composite samples.
Effluent quality and quantity
Approach and minimization-good house keeping, equalization and neutralization by mixing of different effluent streams,, recycling of wastewater streams, process modification in terms of raw materials and chemicals used, Treatment of Industrial wastes, Removal of dissolved and suspended solids, Organic waste treatment process, Sludge treatment and handling**,** Stream water quality, DO sag curve, etc.
General Approaches to Planning of Industrial Wastewater Treatment and Disposal
Equalization and proportioning, neutralization, Treating different effluent streams separately, Treating different streams jointly after mixing them partly or fully including/ excluding domestic wastewater along with the Industrial waste, Treating Industrial waste along withy town waste**.**
General Approaches for handling and Treatment of specific Characteristics of Industrial Wastewaters
Approaches for treating wastes having shock loads, colours, toxic metal ions, refractory substances, e.g. ABS and other detergents, growth inhibition substances such as insecticides, high concentration of nutrients (N.P.K), oil and grease, suspended solids, BOD,hot waste, waste with acidity, alkalinity etc.
Process flow Diagrams, Characteristics and treatment of various Industrial Wastes : pulp and paper, textile, tannery, food, sugar mill, distillery, dairy, pharmaceuticals, electroplating, refinery etc.

CE 803/12 Environmental Impact Assessment and Auditing Full Marks – 100

3 – 0 – 0

Planning and Management of Environmental Impact Studies. Impact indentation methodologies : base line studies, screening, scooping, checklist, networks, overlays. Prediction and assessment of

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impacts on the socio-economic environment. Environmental cost benefit analysis. Decision methods for evaluation of alternatives. Case Studies. Environmental impact assessment at project level, regional level, sectoral level, and policy level. Sustainable development; Environmental policy in planned, mixed and market economies; global environmentalism. Preventive environmentalism. Preventive environmental management.

CE 803/13 Solid and Hazardous Waste Management Full Marks – 100

3 – 0 – 0

Identification, characterization and regulatory requirements for disposal of hazardous, nonhazardous and domestic wastes. Transport of Municipal Solid Waste, Routing and Scheduling, Site selection and Geoenvironmental process and mechanism of attenuation. Design practices of solid wastes. Tailing dams for disposal of flyash, coal, copper, iron and other metal wastes. Single and double lined landfill design, linear material clay, geosynthetics amended soils and other admixtures. Leachate collection and detection system. Landfill construction. Construction quality control and performance monitoring. Application of geosynthetics in waste disposal design, Site remediation.
Biomedical wastes : definition; category; handling; treatment and disposal
Radioactive wastes

CE803/14: Pavement Design Full Marks – 100

3 – 0 – 0

Pavement structure elements; Performance criteria; Characteristics of traffic load ; Estimation of Design Traffic; Analysis of stresses in flexible and rigid pavement; Design of embankment and subgrade; Design of flexible and rigid pavements by IRC, AASHTO and other methods; Concept of structural and functional failure, Pavement distress; Strengthening of pavement and Overlay design; Pavement maintenance; Economic Analysis; Preparation of Project Report.

CE803/15: Transport System Planning Full Marks – 100

3 – 0 – 0

Transport System; Inter Relationship with social & economic system; Transportation planning process; Urban transportation planning; Transport Demand Analysis Models – Trip Generation, Trip Distribution, Modal choice & Trip assignment ; Land-use Transport models; Regional transportation planning; Transportation planning surveys; Appraisal & evaluation of transport plan; Planning for parking areas & terminals; Transit system Planning; Parking studies; Integrated transportation system plan.

CE803/16: Advanced Airport and Railway Engineering Full Marks – 100

3 – 0 – 0

Introduction to Air Transportation: Characteristics of Aircrafts related to airport design; Obstruction clearance; Runway – Orientation, Capacity, Configuration, Geometric design; Taxiway – Layout, Geometric Design, Exit taxiway; Design of Apron; Design of Hanger; Design of Terminal building; Airport planning and Site selection; Pavement design and drainage, Air Traffic Demand Forecasting.

Role of Railway Transportation; Features of Indian Railways; Principle of traction and tractive resistance; Permanent way materials – Rail, joints, sleepers, ballasts, fittings; Railway geometric design; Turnouts and crossovers; Signaling Control System stations & Yards ; Track Maintenance; Track modernization ; Rail Rapid Transit, Rail Traffic Demand Forecasting ;

CE 851/X: Sessional and Tutorial Works on CE 803/X Full Marks – 100

3 – 0 – 0

ELECTIVE - II

CE804/1: Prestressed / Composite Structures Full Marks – 100

3 – 0 – 0

Need for prestressing; Pretensioning and Post-tensioning methods; Behaviour of prestressed concrete beams; Loss of prestress; Deflections ; bursting forces in anchorage zone; Design methods; Partial prestressing; Analysis of indeterminate structures. Need of composite construction; Design methods for composite beams, slabs, columns and box -girdess; Behaviour of masonry elements and walks; Design methodology; Stability of columns and walks; Seismic Design; reinforced and prestressed masonry.

CE804/2: Offshore Structures Full Marks – 100

3 – 0 – 0

Introduction: types of offshore structures – materials and their properties – stochastic processes – structural analysis – multi-degree freedom system and random vibration – finite element analysis – hydrodynamics – waves theories – Morison's equation – flow induced vibration – waves forecasting – fluid structure interaction problems – marring soil and their properties – soil structure interaction problems – marine corrosion – fatigue – reliability – design aspects – construction and launching – oil pollution and its control.

CE804/3: Bridge Engineering Full Marks – 100

3 – 0 – 0

Review of standard specifications for road and railway bridges, Hollow box girder bridges, Skew deck slab, Bridge dock curved in plan. Prestressed concrete (compositer) bridges, Cable – stayed grinder bridges, Bridge bearings, Well foundation.

CE804/4: High Rise Structure Full Marks – 100

3 – 0 – 0

Wind and seismic loads in high – rise structures. Response of high – rise structures to lateral loads and design consideration.
Application to: Guyed towers, Chimneys and stacks, Tall buildings: multi – storied frames; Shear walls of various types; frame – Shear wall interaction; staggered wall – beam system. Electrical transmission towers.

CE804/5: Damage Assessment And Retrofitting Full Marks – 100

3 – 0 – 0

Evaluation of condition of structures – visual, N.D. tests, load tests and others. Reasons for distress – wear and tear. Support settlement, foundation sinking, over-loading and aggressive environment effects. Defects in construction material. Effect of earthquake, wind, flood and fire. Changed requirement / utility. Insufficiency of original designs. Rectification of defects. Strengthening of structures. Replacement of defective portions. Erection loads. Remedial construction techniques. Case studies for different types of structures. Introduction to System Identification Methods, Damage detection of Structures from measured response

CE804/6: Rock Engineering Full Marks – 100

3 – 0 – 0

Introduction – objective, scope and problems of Rock Mechanics. Classification by origin, Lithological, Engineering. Rock exploration – rock coring, geophysical methods. Laboratory testing of rocks – all types of compressive strength, tensile strength and flexural strength tests. Strength and failure of rocks – Griffith's theory, Coulombs theory, rheological methods. In-situ tests on rock mass. Deformation characteristics of rocks, instrumentation and measurement of deformation of rocks. Permeability characteristics – interstitial water on rocks, unsteady flow of water through jointed rock mass. Mechanical, thermal and electrical properties of rock mass. Correlation between laboratory and field properties. Analysis of stresses. Thick wall cylinder, formulae, Kreish equation, Green span method. Openings in rock mass and stresses around openings. Pressure tunnels, development of plastic zone. Rock support needed to avoid plastic deformation. Lined and unlined tunnels. Underground excavation and subsidence. Rock mechanics applications. Bearing capacity of homogeneous as well as discontinuous rocks. Support pressure and slip of the joint. Delineation of types of rock failure. Unsupported span of underground openings, pillars. Rock slopes. Rock bolting. Plastic mechanics. Tunnels, shapes, usages, Methods of Construction, Problems associated with tunnels, tunneling in various subsoil conditions and rocks.

CE804/7: Environmental Geotechnics Full Marks – 100

3 – 0 – 0

Fundamental issues of waste problem; regulations, waste generation and disposal, composition and engineering properties of waste soils. Effects of contaminants on engineering properties of soil; clay mineralogy, clay – water – electrolyte system, soil - water – contaminant interaction. Remediation and stabilization of contaminated ground; bioremediation, soil washing, thermal treatment, solidification, ground improvement application. Contaminant transport; advection, diffusion, dispersion, chemical reactions, dispersion coefficient, distribution coefficient, retardation factor, contaminant transport modeling. Design of liner, cover, cut off walls, leachate collection and removal system. Waste utilization; stability, settlement, seismic consideration, field quality control.

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CE804/8: Probabilistic Methods In Geotechnical Engineering

Full Marks – 100

3 – 0 – 0

Basic concept of reliability – Definition, need of reliability analysis, measures of reliability, Fundamentals of structural reliability analysis, modeling of load, resistance.

Geotechnical reliability analysis – Risk and safety factor concept, partial safety factor method, safety index, various first order and second order reliability analysis method, reliability with correlated variables, in reliability analysis for non Gaussian variables and related transformation. Reliability based design and optimization.

CE 804/9: Advanced Hydraulic Structures Full Marks – 100

3 – 0 – 0

Dams: Investigation survey, Selection of dam site, Selection of type of dam. Classification, Geological Investigation, Field Exploration, Spillways and energy dissipation.

Earth and Rockfill Dams: Causes of failures and remedial measures, selection of earth dams,

Criteria for safe design of an earth dam, Section of an earth dam, Phreatic lines, seepage loss

through earth dams, Stability analysis, Control of seepage through earth dams, Slope Protection,

Design considerations in Earthquake Regions, Rockfill dams.

Gravity Dams: Forces acting on gravity dams, Modes of failures, Load combination for design, Elementary profile, Stability analysis, Control of cracking, Galleries.

Structures on permeable foundations: Modes of failures, Bligh's Creep theory, Lanes weighted creep theory, Potential flow theory, Khosla's method of independent variables, Design of barrages.

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Cross Drainage Structures: Brief Descriptions about types and layout of cross-drainage structures and canal fall structures.

CE804/10: Environmental Systems Management Full Marks – 100

3 – 0 – 0

Groundwater as a resource, general problems of chemical contamination in groundwater. Fluid potential, hetrogenity and anistropy. Aquifiers, aquitrads and general geology, well hydraulics, parameter estimation. Steady and transient flow equations, unsaturated flow equation. Pollutant transport in groundwater, chemical and transport processes, numerical modeling and solution, break through curves. Seawater intrusion in coastal aquifiers. Modelling of pollutant transport in the unsaturated zone. Optimization models for management of groundwater quantity and quality. Optimal monitoring network design. Multiple objective management. Conjective management of surface and groundwater. Special topics

CE804/11: Rural Water Supply and Sanitation Full Marks – 100

3 – 0 – 0

General
Concept and scope of environmental sanitation in rural areas, Magnitude and problems of water supply and sanitation in rural areas in India, National policy.

Water Supply
Quality aspects: Specific impurities and their significance, Design population, Demand and variations, Planning of water supply schemes in rural aresas: individual village and group schemes, Source of water supply: Springs, wells, infiltration wells, radial wells, infiltration galleries and surface water intake, Treatment of water for rural water supply, Compact system**:** multibottom settler, slow sand filter, diatomacesus, earth filter, cloth filter, chlorine diffuse cartridges, pumps, pipe, materials, appurtenances and improved device for use in rural water supply schemes, Distribution system for rural water supply.

Disposal of Night Soil and Wastewater
Various methods of collection and disposal of night –soil: sanitary latrines, community latrines, septic tanks, soakage system anaerobic filter, Imhoff tank, compact and simple wastewater treatment units: stabilization ponds, revolving biological surfaces.

Biogas Plants
Quantity of cow dung, required capacity and design.

Disposal of Solid Wastes
Composting, landfilling, incineration.

CE804/12: Air Pollution Full Marks – 100

3 – 0 – 0
Definition; Air pollution episodes; Source classification; Types of air pollutants; Sampling of air pollutants and its analysis; Ambient air quality standard; Air quality index; Meteorology and air pollution; Air pollutant dispersion models; Air emission control.

CE 804/13: Construction & Maintenance of Highways Full Marks – 100

3 – 0 – 0
History of road construction ; Basic characteristics of soil & pavement materials ; Specifications & methods for construction of embankments; Subgrade, Drainage layers & Granular subbase ; WBM & WMM ; Surface dressing ; Premix carpet ; Bituminous Macadam, and dense Bituminous Macadam, Asphalt concrete, Mastic asphalt ; Bituminous mix design ; Soil Stabilization; Superpave, Concrete pavement; RCCP construction, CRCP; Construction equipments; Quality control, Field tests; Construction management for road project; Maintenance & pavement, Maintenance management ; Construction of hill roads.

CE 804/14: Safety, Environment and Energy in Transportation Full Marks – 100

3 – 0 – 0
Vehicle, Roadway, driver characteristics ; Planning for traffic safety in Urban streets, Highways and Rural Roads; Roadway design for safety; Safety in Hill roads; Crash and injury causations; Crash models; Accident Studies; Accident cost; Enforcement and Education aspects for safety; Road Safety Audit.

Transport related pollution; Noise pollution, traffic noise sources; Road transport related air pollution, sources of air pollution, effects of weather conditions, Pollution standards; Measurement and analysis of vehicular emission; EIA requirements of Highways projects.

Energy consumption in Transportation; Energy related aspects of different transport technologies. Energy Conservation & alternative sources; Energy Audit.

CE 804/15:Advanced Port, Harbour and Waterway Engineering Full Marks – 100

3 – 0 – 0

Role of water transportation ; Basic considerations of Ocean Winds, waves, tides; Ship characteristics and their influence on ports management and operations; Planning and layout of port, dock, harbour, jetties; Different components of port and harbour; Design of Breakwater; Cargo handling systems; Economic evaluation; Basic operational principles; Function of Port Authorities; Concept of Inland water transportation; Design for Inland water transportation system; Planning of trans-river mass transportation.

CE 852/X: Sessional and Tutorial Works on CE 804/X Full Marks – 50

0 – 0 - 3

CE 853: Project – IV Full Marks – 200

0 – 0 – 9

Sessional Work, based on different opecialisation of civil Engineering

CE871: Comprehensive viva voce - II Full Marks – 100

0 – 0 – 0

Elective-III (Non-Dept./ Dept.) [CE 805/x]

CE _805/1 Transportation in Logistics & Supply Chain Management

Full Marks – 50

2 – 0 – 0

Role of Transportation in Economic Development and Business Operation ; Forms & Modes of Transportation and their characteristics.

Introduction to Business Logistics & Supply Chain Management: Concept of Business Logistics; Fundamentals of Business Operation; Concept of Supply Chain Management; Supply Chain & Competitive Performance; Logistical Functional Areas; Logistical Cost Elements

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Freight Transport in India: Modal Shares & Growth of Goods Vehicles; Road Freight Transport Industry Structure; Problems of Road Freight Transport Industry; The Emerging Trends

Freight Transport Cost: The Principles; The Factors; The Cost Elements – Line Haul Cost, Pick-up Delivery Cost, Terminal Handling Cost, Billing & Collecting Cost; Fixing the Rate of Freight

Transportation & Physical Distribution System: Distribution in Logistics & Supply Chain Management – Channels of Distribution, Distribution Activities, Customer Focused Distribution Logistics, Warehousing & Distribution Centres; Transportation Consolidation; Integrated Management of Warehousing & Transportation System – Warehousing & Transportation Costs, Multi Warehouse System, Distribution System Service Level; Integrated Logistics System Design – The Process, Analytical Techniques & Modeling

CE _805/2 Transportation System Analysis Full Marks – 50

2 – 0 – 0

Quantitative analysis of traffic system ; Basic of Simulation modeling; Traffic Simulation Model formulation; Traffic demand modeling techniques; Statistical technique in transportation planning.

CE _805/3 Advanced Remote Sensing and GIS Full Marks – 50

CE_805 / X Other Civil Engineering Department Subject (S)

2 – 0 – 0

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DEPARTMENT OF COMPUTER SCIENCE AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND TECHNOLOGY

APPROVED SYLLABUS for UNDERGRADUATE (B.E.) COURSE

1st & 2nd semester B.E.. Courses

CS 1201 **INTRODUCTION TO COMPUTING** **(for all Engg. Branches)**

SEMESTER EXAMINATION:	**CONTRACT PERIODS: (2 L + I T)**
TIME – 2Hrs.	**Continious Assessment :**
Full Marks -35	**Full Marks -15**

NUMBERSYSTEM & CODES

Positional & non positional number systems, Binary, Octal, Hexadecimal number system& Conversion, Representation of negative numbers & real numbers, Fixed and floating point numbers. Characteristics codes (ASCII, EBCDIC etc.) & others like Grey, Excess-3 etc.

ARITHMETIC & LOGIC

Logic operations & gates, Half adder.
& full adder subtraction using add. Repetitive addition & subtraction to accomplish multiplication & division etc.

COMPUTER ORGANISATION

CPU, Memory & I/O devices – Commonly used peripherals.
Role of the CPU, Memory and I/O devices in the context of solving a problem.

PROBLEMSOLVING STEPS & PROGRAM DEVELOPMENT CYCLE

Systemetic decomposition, Flowchart, Algorithm, the three constructs (sequential, conditional and iterative). Edit, compilation, Debugging & execution.

INTRODUCTION TO PROGRAMMING IN C

Idea of High level, Assembly level & M/c level language.
Interpretation and compilation.
Variables and data types (basic), simple programs,
assignment, decision, loops, scope: Global & local,
control structure (if, if-else, switch, for, while, do while, break and continue)
Structural data type (Array, record, file, set etc.), Function, recursion, introduction to dynamic data structure.

CS 1251 **COMPUTING PRACTICE** **(for all Engg. Branches)**

Full Marks – 50 Contact Periods : (3S)

Following experiments are recommended based on the course **Introduction to Computing (CS 1201) :**

PROGRAM DEVELOPMENTIN UNIX ENVIRONMENT

Simple file handling and editing commands in suitable O.S (UNIX/ LINUX) environment & file structure. Batch files etc. servers/Clients and terminals in a Network environment. Edit, compile, link, debug and execute.

PROGRAMMING PROBLEMS

Programming problems covering all the aspects of C language and introductory numerical analysis problems.

ERROR PROPAGATION & COMPUTATION TIME

Rounding & truncation error. Execution time of a process. System time & user time etc.

DEBUGGING

Methods and tools.

3RD SEMESTER – COMPUTER SCIENCE AND TECHNOLOGY

CS 301 **DIGITAL LOGIC**

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Diode as a switch. Use of diode in AND, OR circuits. Transistor as a switch. RTL,DTL,TTL logic gate circuits. MOS as a switch. Basic MOS inverter. MOS and CMOS logic gates. Fan in and Fan out capability of logic gate, propagation delay.

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Boolean Algebra - Postulates and axioms. Representation of truth table - POP and POS forms. Application in design of Adder, Parity generators, coda Converters. NAND/ NOR realisation. Exclusive OR functions. ALU combinatorial logic minimisation with K-map and Quine McCluskey method. Use of multiplexers and De-multiplexers in realisation of logic functions. Encoders and Decoders. Concept of Tristable logic and strobing

Sequential Network- Latch and flipflop. Systhesis of flipflop with combinatorial logic

gates, clocking methods. Synchronous and Asynchronous counter, Up and Down counting Resisters. Analysis and synthesis of sequential circuits - Moor and Mealy model description, state diagram and state table - Minimisation methods. Use of memory circuits. Racing and Logic hazards. Implementation of hazard free logic circuit.

CS 302 DATA STRUCTURES & ALGORITHMS

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Concepts of data Structures – Information & Meaning, Abstract data Types.
Linear Data Structures – Sequential Representations :
Arrays and Lists, Stacks, Queues and Dequeues and their Applications; Linked Representations: Linear Linked List, Circular Linked List, Doubly Linked List and their Applications.

Nonlinear Data structures : Trees : Basic Terminologies; Binary trees: Properties, Traversals and Threads, Expression Tree, Binary search tree: Operations, Height Balanced Binary trees; M-Way Search Tree, B- Trees; Applications. Heaps & Priority Queues.
Graphs: Graph Terminologies, Representation of graphs, Graph Traversals, Application of Graphs.
Sets : Definition & Terminologies, Representation of Sets, Operations of sets, Applications.
Time & Space analysis of Algorithms – Order Notation.
Recursion – Design of Recursive Algorithms, Tail Recursion, When not to use recursion, Removal of Recursion.
Shorting Algorithms: Insertion sorts : Straight insertion sort, Binary insertion of sort, Shell sort; Exchange
Sorts: Bubble sort, Quick sort, selection sorts: Straight Selection Sort, Heap Sort; Merge sort; Distribution Sorts :
Bucket Sort, Radix Sort.
Searching: Sequential Search, Ordered Sequential Search, Binary Search, Interpolation Search.
Hashing,: Hashing Methods, Hash Function Implementations, Hash Tables, Scatter Tables, Scatter tables using Open Addressing.

CS 351 DATA STRUCTURES ALGORITHMS LAB

Full Marks – 50 **Contact Periods : (3S)**

Programming Experiments based on: Arrays, Stacks, Queues, Linked lists, Trees, Recursion, Sorting, searching and Hashing data structures.

CS 352 DIGITAL LOGIC LAB

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Full Marks : 50 **Contact Period : (4S)**

Laboratory works based on Theory papers CST 301.

4th Semester - COMPUTER SCIENCE AND TECHNOLOGY

CS401 Discrete Structures

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Sets, Relations, Functions : Basic definition & operations, Countable & uncountable sets, Cantors Diagonal arguments, Different types of relation & functions etc.

Partially order sets: Basic Definition & relations, different types of lattices , Boolean Algebra.

Algebraic Structures: Semigroup, monoid, group, ring, integral domain, field.

Principle of mathematical induction, Partition of integers, Integer functions, Numeric Functions, Order notations, Generating Functions, Recurrence relations and it's application in analyzing algorithms

Graph theory: Introductory concepts, trees, Planarity, Connectivity and Separablity, Cut Space and Cycle Space, colouring & related problems, Graph Enumerations.

Logic :

Proof Techniques : Proof by Exhaustive checking, Conditional proof , Proving the Contrapositive, Proof by Contradiction, If and Only If Proof, On Constructive Existence.

Sets : Definitions of a Set, Operations on Sets, Counting Finite Sets, Bags (Multisets).

Ordered Structures : Tuples, Lists, Strings and Languages, Relations, Counting Tuples.

Inductively Defined Sets : Numbers, Strings, Lists, Binary Trees, Cartesian Products of Sets.

Equivalence, Order and Inductive Proof : Composition of Relations, Closures, Path Problems; Equivalence Relations – Definitions and Examples, Equivalence Class, Partitions, Generating Equivalence Relations; Order Relations – Partial Order, Topological Sorting, Well – Founded Orders; Inductive Proof; Proof by Mathematical Induction, Proof by Well – Founded Induction, A Variety of Examples.

Elementary Logic : The Origins of Mathematical Logic,
How Do We Reason ? ; Propositional Calculus : Boolean Operators, Well – Formed Formulas and Semantics, Interpretations, Logical Equivalence and Substitution, Satisfiability, Validity, Truth Functions and Normal Forms, Logical Consequence, Formal Reasoning : Inference Rules, Formal Proof.

Predicate Logic : First Order Predicate Calculus – Terms, Predicates and Quantifiers, Well – Formed Formulas, Semantics and Interpretations, Validity, The Validity Problem; Equivalent Formulas : Equivalence, Normal Forms, Formalizing English Sentences ; Formal Proofs in Predicate Calculus.

CS402 Computer Organization

Semester Examination : Contact Periods : (3L+ 1 T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 70. **Full Marks – 30.**

Basic organization, block level description. Assembly language programming, instruction set, instruction cycles, registers and storage, addressing modes. Processor design, information representation, computer arithmetic and their implementation, design of ALD. Controller design. Memory and 10 access, memory maps, programmed 10, DMA. Interrupts. 10 subsystems, input-output devices, interfacing 10 devices. Memory organizations, static and dynamic memories; Cache memory and memory hierarchy; Virtual memory. Introduction to multiprogramming and multiprocessing. Pipeline architectures.

CS403 Object Oriented Technology

Semester Examination : Contact Periods : (2L+ 1 T)
Time-2hrs. **Internal Assessment :**
Full Marks – 35 **Full Marks – 15.**

Review of OOP. Importance of OOP over procedural languages and software crisis. Classes and methods – encapsulation, message passing, base and derived classes, virtual base class, constructor, multiple inheritance. Operator and function overloading. Runtime Polymorphism.

Case studies – Object Oriented Design, analysis, implementation. Introduction to UML(Unified Modeling Language)

Introduction to Java Programming, Introduction to OO technologies.

Lab – Using Object Oriented features using C++.

CS404 Electronic Design Automation

Semester Examination : Contact Periods : (3L+ 1 T)
Time-3hrs. **Internal Assessment :**
Full Marks – 70 **Full Marks – 30.**

Design of regulated power supply and switching mode power supply (SMPS).

Specification of analog circuit components. Design of analog and mixed signal circuits.

Review of Metal Oxide semiconductor (MOS) and Bipolar junction transistor (BJT) based circuits. Examples with standard TTL and CMOS packaged devices.

Simulation of logic circuits using P-SPICE and other related tools.
VHDL, VERILOG programming for verification of analog and digital circuits. Introduction to other computer aided design packages.

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CS451 Object Oriented Technology Lab

(Sessional Subject)

Full Marks – 50. Contact Periods : 3S

Sessional work based on the course "Object Oriented Technology" (CS 403)

CS452 Electronic Design Automation Lab

(Sessional Subject)

Full Marks – 50. Contact Periods : 3S

1.Experiments on various compiler directives in verilog.

2.Write verilog code to observe the difference between case equality and logical equality operator.

3.Observe the difference between blocking and non-blocking procedural assignment statement experimentally.

4.Verify the difference between task and function experimentally.

5.Write verilog code to verify the truth table of various combinational and sequential circuits.

6.Write the VHDL description of a 16:1 MUX.

7.Observe the difference between various wait statements in VHDL code.

8.Verify the difference between the following in VHDL code:
(i) Signal and Variable
(ii) Concurrent and Sequential assignment statement.

9.Verify the use of sensitivity list in VHDL code.

CS453 Computer Organisation Lab

(Sessional Subject)

Full Marks – 100. Contact Periods : 4S

Sessional work based on the course "Computer Organisation " (CS 402)

CS454 DISCRETE STRUCTURE LAB

(Sessional Subject)

Full Marks : 50 Contact Period : 3S

Programming for manipulation of Discrete Structures like Set, Relation, Function, Hashing and recursive Function, Minimization of Boolean Function, etc. Programming related to Graph

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Representation, Path Reachability, Tree Traversal, etc. Implementation of Graph Algorithms under UNIX environment.

5th Semester - COMPUTER SCIENCE AND TECHNOLOGY

Operating Systems (CS501)

FM - 100 **Contact Periods: 3L + IT**

Overview of Operating Systems:
Batch Processing, Multi-programming, Time Sharing and real Systems.
Process Management:
Process Management and Control, Concept of a process, Process control, IPC.
Threads and Symmetric multiprocessing
Processes and Threads, Symmetric Multiprocessing, Solaris, Linux and Windows threads
Processor Scheduling
Uniprocessor Scheduling, Multiprocessor and Real time scheduling
Concurrency: Mutual Exclusion and Synchronization Critical Section Problem
Semaphores, Monitors, Classical Problems of Synchronization
Concurrency: Deadlock and Starvation: Principles of Deadlock, Deadlock avoidance, Deadlock Detection, Recovery from Deadlock, Thread synchronization, Combined approach to deadlock handling
Memory:
Memory Management, Logical and Physical address space Swapping, Paging, Segmentation.
Virtual Memory: Demand Paging, Page replacement algorithms Frame allocation
Thrashing
Device management.
Information management- File system, Security.
A case study of UNIX.

Computer Architecture(CS502)

FM - 100 **Contact Periods: 3L + IT**

Overview: Von Neumann *m/c* architecture, instruction sets and their design issues, optimal coding algorithms, high speed arithmetic units, ALU; Control Unit, hardware and microprogrammed control design, optimization; Memory and I/O device interfacing, data transfer schemes; CISC and RISC processors.

Pipelining: Basic concepts, linear and non-linear pipe, hazards, overcoming hazards.

Memory Subsystems: High speed memories, memory interleaving, associative memory; Memory hierarchy, cache memory organizations, reducing cache misses, coherence and locality properties; Virtual memory organization, mapping and management techniques

Instruction-level parallelism, concepts, techniques for increasing ILP; Superscalar, superpipelined and VLIW processor architectures; Multiprocessor architecture, parallel architectures, shared-memory architecture, synchronization, memory consistency, interconnection networks; Non Von Neumann

Microprocessor Based System Design (CS503)

FM - 100 **Contact Periods: 3L+1T**

Review of Digital logic and logic Devices. CPU Architecture,BUS and system concept.

Processor Programming Model, Assembly language programming. Cross assembly, downloading and object files.
Machine Cycle and Timing, BUS Arbitration, Memory and I/O devices. Address decoding, Memory and I/O interface
System Support devices e.g., PPI, DMA & Interrupt Controller, USART, Timer etc, DMA, Serial communication
Microcontroller and their use in embedded applications. Small system design principles & case study (Design and development of a system development kit: Assembly of h/w modules and development of the monitor program).
Architectures, data flow machines, systolic architectures.
RISC & advanced CISC processors- Enhanced instruction and architectural support, Memory management & Multiprocessing etc.

Design & Analysis of Algorithms (CS504)

FM : 100 **Contact Period : 3L + 1T**

Notion of Algorithm Complexities: Time and Space complexities; Worst, Average and Amortized Time Complexities: Techniques for Amortized analysis.
Standard Techniques: Divide and Conquer, Dynamic Programming, Greedy, Branch and Bound, Backtracking techniques
Standard Data Structures: Dictionary, Priority Queue, Mergable heaps, Concatenable Queues, Hashing.
Algorithms for: Sorting- Lower bound, Randomized Quicksort, Heap Sort, Linear time Algorithms for Special instances; Matrix Multiplication and related problems; FFT Algorithms and Polynomial Multiplications, Network Flow Algorithms, NP- Hardness, Notion of Approximation Algorithms

Operating System Lab (CS551)

FM : 100 **Contact Period : 3S**

Laboratory Work Based on the Theory Paper CS501

Algorithm Lab (CS552)

FM : 50 **Contact Period : 2S**

Implementation of the algorithms and experimentations on them as in the theory papers CS504. Emphasis on implementation of algorithms designed using suitable data structures so as to get most efficient implementation.

Microprocessor Based System Design Lab (CS553)

FM : 100 **Contact Period : 4S**

Section I:
Familiarization I - Idea and operation of system Development Kit (SDK), Executing hand coded simple programs.
Familiarization II : Hardware of SDK etc., Executing harder programs.
Debugging: Debugging techniques, Break points, Single step etc.
Simple I/O - Interfacing simple I/O devices, I/O instruction, Memory mapped and I/O mapped, I/O concept etc.
Serial I/O _- Interfacing Simple I/O Devices, I/O instruction, Memory mapped & I/O mapped, I/O concept etc.
Display - Different types of display with special emphasis

Keyboard: Different types of keys, Interfacing matrix keyboard.
Section II
Design and development of SDK - Hardware Design of SDK, Software Monitor routine for SDK.

6th Semester - COMPUTER SCIENCE AND TECHNOLOGY

Analysis, Design & Management of Information Systems (CS601)

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FM: 100 **Contact Periods: 3L + 1T**

Systems concepts – Characteristics, types, boundaries, subsystems, organizational system, information system, systems approach to management, MIS and its role in organization;
Types and functions of MIS, tools of MIS; control and feed-back of information systems, feed-forward control; information quality, information value chain;
Various models used in information systems especially in MIS such as CSF model, strategic planning model, management control model etc.;
Basic concepts on design of information systems for MIS oriented applications;
Decision making process, structured and unstructured decisions, concepts on DSS, ES, KBS etc.;
Socio-technical aspects of MIS.

Theory of Computation (CS602)

FM: 100 **Contact periods :3L+1T**

- Review of Sets, Relations, Functions, Closures
- Alphabets and Languages, Finite representation of languages, regular expressions and languages.
- Deterministic and non-deterministic finite automata, regular expression versus automata, properties of the class of regular languages, pumping theorem for regular languages, language recognizer and language generator, regular grammar and derivation under regular grammars, finite automata versus regular grammars.
- Context free grammars and pushdown automata, Deterministic pushdown automata, Parse Trees, Properties of Context Free Languages, Pumping theorem for Context Free Languages, Parikh's theorem.
- Turing Machine and its extensions, Turing computability, Unrestricted Grammar, Grammatically Computable functions, Chomsky hierarchy of languages, Churches thesis" Primitive recursive functions. Cantor and Godel numbering. Ackennann's function, murecursive functions, Universal TM and Undecidable problems

Computer Networks (CS603)

FM : 100 **Contact Period : 3L+1T**

Introduction:

Goals and Applications, Layered Model and Protocol Issues,,Network Design issues,
OSI reference model and services, Protocols and Standards.

Data Communication Fundamentals:

Channel Characteristics, Various transmission media, Different Modulation techniques

Network Structure:

Concepts of subnets, backbones and local access Channel sharing: FDM and TDM
Message transport: Circuit, Message and Packet switching Topological design of a network

LANs and their interconnections:

Basic concepts, Architecture, Management and performance of Ethernet, Token Ring and Token Bus protocols, Repeaters, Bridges and Hubs

Data Link Layers:

Services and Design issues, Framing techniques, Error Handling, Flow control, Stop and Wait, Sliding Window, HDLC Protocol

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Network Layer:

Design issues, Routing algorithms, Congestion Control Techniques, Network architecture and protocols, TCP/IP, UDP etc.

Issues in presentation Layer

Application Layer:

Network security, DNS, SNMP, Electronic Mail

Wireless and mobile communication:

MACA & MACAW, GSM, CDMA

Internet:

IP Protocol, Internet control protocols, ICMP, ARP and RARP. Internet routing protocols: OSPF, BGP and CIDR

Distributed Systems:

Introductory concepts and definitions, Distributed operating systems, Formal Protocol Models Network Management Methods Control mechanism, Distributing network s/w

Database Management Systems (CS604)

FM: 100 **Contact Periods: 3L+1T**

Basic Concepts; Schema architecture; Storage structure, Data models- Hierarchical, Network and relational; ER/EER diagram and informal table schema; Relational algebra and relational calculus, Query languages- SQL, PL/SQL etc.; Normalization theory and Database design methodologies; Issues in DBMS implementation- Security, Recovery and Concurrency control; Query processing and optimization. Introductory overview of distributed database and object relational database.

System Programming (CS605)

FM 50 **Contact Periods: 2L+1T**

Design of Assembler- Statement of the problem.
Algorithms for one pass and two pass assembler, Data structures and implementation details, reloccatable assembly etc.

Macro Processor- Definition, Expansion, Nested macro definition and call, Data Structure & Implementation, Conditional Macro.

Linker- Statement of the problem, Public and External Table, Linker algorithm, Relocation, Linking library module, Dynamic Linking etc.

Analysis, Design & Management of Information Systems Lab (CS651)

FM : 50 **Contact Period : 2S**

Laboratory exercises based on the theory subject CS601

DBMS Lab (CS652)

FM : 50 **Contact Period : 2S**

Laboratory work based on the theory paper CS604

Computer Network Lab (CS653)

FM : 50 **Contact Period : 3S**

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Laboratory work based on the theory paper CS603

Systems Programming Lab (CS654)

FM : 50 **Contact Period : 3S**

(Prerequisite – Preliminary idea of Assembly Language & C Programming language: Interrupt, User supervisor mode of operation etc.)

Assembly language programming to examine various aspects of DOS in the context of interrupt, TSR, Overlay etc.
DOS enhancement – HEX dump and other
Utilities, Process time measurement, Interprocess communication.

Design of a typical 2-pass assembler, relocatable assembler, Macro assembler, Design of EXE file, loader and Device Driver.

Digital Systems Design Lab (CS655)

FM : 100 **Contact Period : 3S**

Familiarisation and Experimentation with FPGA, DSP, Microcontrollers.

Implementation of projects in embedded system design environment.

Viva-Voce I (CS671)

FM : 100 **Contact Periods: Nil**

Viva voce on all 2nd and 3rd year theoretical subjects

7th Semester - COMPUTER SCIENCE AND TECHNOLOGY

Computer Graphics (CS701)

FM : 100 **Contact Period : 3L + 1T**

INTRODUCTION:
Objectives, applications, implementations. Aspect Ratio. Object and Background, 4-neighborhood and 8-neighborhood.
Storing Drawings (and Images) in 2-d Arrays and Files.
Programming in turbo-C in DOS vis-a-vis in C / Java in Linux and Unix. Chain Code Representation - Absolute & DifferenceChain Codes.
GEOMETRIC PRIMITIVES:
Digital Straight Line Segments (DSS) - Incremental Algorithm. Scan Line Algorithm by Bresenham. Dashed Lines, Dotted Lines, Thick Lines. Digital Circles - Bresenham Algorithm.
Thick Circles, Arcs, Pie Charts (Refer Filling). Curve Drawing - applications. Different Types of Curves and

Comparisons. Quadratic & Cubic Curves: Need for Cubic Curves. Conditions for Smooth Curves. Parametric Continuity and Geometric Continuity. Lagrange, Bezier, Hermite, and B-Spline Curves. Basis Matrix and Blending Function. 3-D Surface Generation.

FILLING:

Filling Simple Figures, viz. rectangles, triangles, convex polygons, circles, etc.

Recursive Flood Fill Algorithm and its Stack-based Improvement. Scan Line Fill Algorithm with IN/OUT Flag. Special Treatment for Vertex, Horizontal Edges, Slivers for Polygons. Scan Line Algorithm with Edge Tables. Filling With Patterns.

CLIPPING:

Clipping a Point, a Line, a Polygon, and Other Figures, w.r.t. a Window. Sutherland-Cohen Line Clipping Algorithm. Parametric Line Clipping Algorithm.

2D AND 3D TRANSFORMATIONS:

Translation T, Rotation R, Scaling S. Homogeneous Coordinate System. Rotation about an arbitrary point.

PLANAR PROJECTIONS:

Definitions, Conventions, Applications. Types of Projections and Examples. Parallel vs. Perspective Projections. Orthographic Projections and Multiviews. Isometric Projection. Vanishing Point: 1, 2, 3.

HIDDEN SURFACE REMOVAL:

Object Precision Algorithm vs. Image Precision Algorithm. Z-buffer Algorithm. Ray Tracing Algorithm.

RENDERING:

Illumination Models and Applications. Lambert's Cosine Law, Attenuation, Specular Reflection.

Phong Illumination Model. Goraud Shading (Linear Intensity Interpolation Model). Phong Shading (Normal Vector Interpolation Model).

ANIMATION:

Applications, Examples, Implementation Techniques. Tweening. Morphing. Color Dissolve.

ADVANCED TOPICS:

Detection of Straight Lines from a Point Set Using Hough Transform. Convex Hull: Applications and Algorithms. Fundamental Topics of Image Processing Related with Computer Graphics.

Computer Control of Industrial Processes (CS702)

FM : 100 **Contact Period : 3L + 1T**

Review of control system basics Modeling & Simulation of dynamical systems.Space methods of modern Control theory. Sampling process, discrete system modeling,State variable techniques of digital systems, Stability analysis for discrete systems. Digital controllers; Component in h/w controller Algorithms, Interfacing the systems with the Controller. Concepts of Controllability & Observer ability. Filtering, Estimation & Prediction Algorithms in Discrete Domain. Application Examples from the Domain of Aerodynamics, Biology, Process control Plants & other real life Systems.

Compiler Design (CST –703)

FM : 100 **Contact Period : 3L + 1T**

Review of languages and grammars, Compilers and Interpreters -- basic concepts Scanner -- The scanning process, Design using finite state m/cs, Scanner generator (LEX). Parsing -- Top-down and bottom-up strategies: general considerations, Top-down parsing--LL(1), Recursive descent. Bottom-up parsing -- Operator precedence and simple precedence. LR grammars -- LR(0), SLR(1), canonical LR(1) and LALR(1) parsers. Comparison of parsing methods. Symbol tables -- organisations for non-block structured languages (unordered/odered/tree/hash) and block structured languages (stack tables and stack implementations) Runtime storage management -- static allocation; dynamic allocation -- activation records and their usage, recursive procedures. Heap allocation -- storage request and release strategies.

Semantic analysis -- basic concepts; attributed translation; Intermediate codes; Syntax directed translation concepts. Code optimization -- basic blocks and optimization; loop optimization; flow graph analysis, machine dependent optimization.

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Error handling -- Detection, reporting, recovery and repair. Compiler-compilers -- YACC; Code generation. Concepts of Compiler design for object-oriented languages

VLSI DESIGN (CS704)

FM – 100 **Contact Periods : 3L + 1T**

Introduction to CMOS Design; NMOS and CMOS transistor fractures. Operation of MOS transistor as a switch. Design and analysis of nMOS and CMOS ratioed and ratioless inverters, gates, latches and flip- flops.

Fabrication of MOS transistor, stick diagram, design rules and layout. Circuit Characterization and Performance estimation of MOS circuit (Delays, transition width) CMOS Circuit and Logic design, BiCMOS logic gates. Dynamic MOS structures, Registers, Counters and memory realization using MOS logic.

Design Structuring; Regular Structure Circuits, PLA and FSMs, system timing and clocking issues, scaling, CMOS subsystem design.
Low Power circuits and systems.

Elective-I (CS705/X)

FM: 100 **Contact Periods: 3L+1T**

One Subject from the following:

Principles of programming languages (CS705/1)

Language preliminaries, Chomsky hierarchy, Context free languages and push down acceptors; context sensitive language and Linear bounded acceptors;
Trios, Semi-AFl, AFl acceptors, verification of AFL axiom, Quasi-realtime acceptors; AFA characteristics, Substitution theorems, Generation of bounded languages, Non-bounded Language, Pumping Languages, Symbol loops;
Programming languages perspectives – use and comparison salient features of languages like PASCAL, 'C' LISP etc., case studies.

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Modelling and Simulation(CS705/2)

Theory of modeling and simulation -- concept of real system and model. Autonomous and non autonomous model, informal and formal model descriptions. Experimental frame, simplification of models. Formal specification of models -- discrete time, discrete event and cell space models. Model validation procedures. Test of simulation program correctness. Evaluation of computers -- benchmarks, work load, synthetic job, instruction mix. Throughput,. Address stream generation. Hardware and software monitors. Deterministic and stochastic models of memory, CPU, BUS, OS, compilers, etc. Petrinet models, modelling and evaluation of Pipeline and multiprocessing systems.

Parallel Algorithms (CS705/3)

Models of parallel computation, performance considerations and complexity issues. Basic techniques including balanced trees, pointer jumping, Divide and conquer, partitioning, pipelining, accelerated cascading, symmetry breaking. List tree algorithms, ranking, prefix sums, Euler's tour techniques, tree traversals, tree contraction and applications. Searching, sorting and merging techniques, Bitonic merge sort, odd-even transposition, Cole-Vishkin's merge sort. Graph algorithms for connected biconnected components, spanning trees, finding shortest path, Ear decomposition etc. Matrix manipulation algorithms and DFÔ algorithms. Notion of P-completeness, proving P-completeness of some basic problems.

Computational Geometry (CS705/4)

Basic Geometric Concepts: points, lines, polygons; subdivisions;
arrangements; polytopes; cell complexes; different applications of computational geometry.

Geometric Searching: in 1D, 2D, and higher dimensions: fractional cascading; Kd-tree; interval tree; range tree.
Point Location: slab method; trapezoid method; chain method; bridged chain method.

Plane-Sweep Algorithms: intersection of segments; intersection of rectangles; trapezoidation.

Arrangements and duality: computing the discrepancy; duality and dual transforms; arrangement of lines; zone theorem.

Convex Hulls: 2-dimensional convex hull; degeneracies and robustness; dynamic convex hull; Graham Scan algorithm, Jarvis March algorithm, Kirkpatrick-Seidel's algorithm; higher dimensional convex hulls.

Proximity: closest pair; furthest pair.

Linear Programming: half-plane intersection; incremental linear programming; randomized linear programming.

Voronoi diagrams: examples and applications, e.g. Post-Office problem; Doubly Connecetd Edge List; Fortune's Algorithm; Voronoi diagram in higher dimension.

Art Gallery Problem: monotone polygons; polygon triangulation.

Visibility Graphs: shortest paths; computing visibility graphs; robot motion planning.

Graph Algorithms (CS705/5)

Review: Connected Components, Minimum spanning tree,strongly connected components, Single source & All pair shortest path, Transitive closure

Planarity testing Algorithms, Polynomial time algorithms for planar graphs, Network flow algorithms, Algorithms for bipartite and general graph matching,

Perfect graphs: Notion of perfect graphs, Lovasz's theorem, Strong perfect graph conjecture, Polynomial time algorithms for elementary graph problems Interval, Chordal, Comparability Graphs.

Tree Structured graphs and algorithms for elementary graph problems on these graphs.

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Elective-II (CS706/X)

FM: 100 **Contact Periods: 3L+1T**

One subject from the following:

Software Quality Assurance and Management (CS706/1)

Software development life cycle. Analysis & Design tools and techniques.

Verification and validation method, testing, concept of software quality, quality metrics and models. Performance Evaluation.

Concepts of Software reliability, errors, faults, repair and availability.

Relevant Case studies.

Information and Coding Theory (CS706/2)

Definition of entropy. Information and entropy theorem of Shannon, binary symmetric channel, Un-uniform codes: source coding, Source without memory, Mixed entropy.

Introduction to various codes: linear codes and their properties, the Hamming code, the dual code, the perfect code, Golay code and their properties, cyclic codes and BCH codes, properties of BCH codes; Generator polynomial, minimal polynomials, check polynomials etc.

Multimedia Technology (CS706/3)

Introductory ideas on physics of sound and light, physiology and psychology of hearing and vision. Sound recording technology: microphones, loudness, tone control. Film and TV, video signals, computer video standards, graphics file formats, text and hypertext. Digital audio and video, standard interfaces, image processing and compression techniques.

Media production and hardware: audio production- tools and concepts, editing, MIDI. Video production: stages, preproduction planning, production show, post- production and use of computers, 2D and 3D graphics and animation, morphing. Multimedia authoring: windows, OLE; graphics browser, HTML files, Internet based multimedia.

Advanced Computer Architecture (CS706/4)

Introduction to basic computer architecture, reporting performance related issues; RISC processors; Limitations of Von Neumannic architectures; Advantages of multiprocessing; Pipelining, instruction and arithmetic pipeline, hazards, handling hazards, pipeline optimization, improving performance, compilers importance; Parallel processing, classification, interconnection, switching structures and algorithms. Instruction Level Parallelism (lLP), concepts, challenges, compiler support. Super scalar, superpipelined and VLlW processor architectures. Cluster computers. RISC processors, design motivation, hardware software features, pipeline scheduling algorithms, branching mechanisms, register organizations, data dependencies and addressing modes; Case study of RISC processor. Fault tolerant computing, motivation, reliability, redundancy, fault detection, design techniques, performance considerations. Quantum computing, algorithms, design issues, quantum computers

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Data Mining (CS706/5)

Introduction : Knowledge Discovery in Database : The Origins, Purpose, Necessity and Challenges, Data Mining Tasks.
Fundamental Concepts : Types and Forms of Data : Concept, Example, Attribute, ARFF format, Spares Data, Missing Values.
Types and Forms of Knowledge : Contingency Tables, Subgroup Patterns, Rules, Decision Trees, Clusters, Taxonomies and Concept Hierarchies, Probabilistic and casual Networks, Neural Networks.
Data Processing and Exploration : Stages of Knowledge Discovery Processes.
Data Warehousing - data Cleaning and Loading, Warehouse Administration.
Data Reduction - Sampling, Aggregation, Dimensionality Reduction, Feature Subset Selection, Feature Creation, Discretization and Binarization.
Visualization - Motivation, General Concepts, Techniques.
OLAP and Multidimensional Data Analysis.
Classification : Decision Tree Induction - ID3 Decision Tree Learning Algorithm, Inductive Bias, C4.5 and CART Learning Algorithms, Over fitting and Pruning, Measures for Selecting the Best Split, Incorporating Continuous-Valued Attributes, Missing Value Handling.
Rule – Based Classifier - Learning Sets of Rules, Rule – Ordering Schemes, Sequential Covering Algorithms, Learning First – Order Rules and FOIL, Induction as Inverted Deduction, Inverting Resolution and PROGOL.
Nearest – Neighbor Classifier - Instance Based Learning, K- Nearest Neighbor Classifier, Case- Based Reasoning, Lazy and Eager Evaluation.
Bayesian Classifier - Bayes Theorem and Concept Learning, Minimum Description Length Principle, Using Bayes Theorem for Classification, Naïve Bayes Classifier, Belief Networks,
Artificial Neural Network - Perceptrons, Multilayer Artificial Neural Networks, Error Backpropagation, Role of Neural Networks in Data Mining, Rule Extraction, Rule Evaluation, Clustering and Self-Organization.
Association Analysis : Problem Definition, Association Rules, Apriori Principle, Rule Generation in Apriori Algorithm, FP- Growth Algorithm, Evaluation of Association Patterns.
Clustering : Numerical Clustering, Conceptual Clustering, K-means Clustering, Expectation – Maximization Algorithms, DBSCAN, Cluster Evaluation, EM Algorithm, Graph- Based Clustering.
Text Mining : Keyword-Based Search and Mining, Text Analysis and Retrieval, Mathematical Modeling of Documents, Similarity- Based Matching for Documents and Queries, Latent Semantic Analysis.
Web Mining : Web Content Mining- Crawlers, Harvest System, Virtual Web View, Personalization. Web Structure Mining – Page Rank, Clever.
Web Usage Mining – Preprocessing, Data Structures, Pattern Discovery, Pattern Analysis.
Case Studies with Data Mining Tools.

Computer Graphics Lab (CS751)

FM : 100 **Contact Period : 4S**

1. Grid: Construct a square grid with origin (0,0) at center of the display screen.
Use (0,0,0) as the background color and (200, 200, 200) as the grid color.
Show the x-axis and the y-axis with color (0,0,200).

2. Digital Straight Line
3. Digital Circle
4. Cubic Spline
5. Mini Project on Clipping / Filling / Digital Geometry / 3D Projections / Hidden Surface Removal / Rendering / Illumination / Animation.

Computer Control of Industrial Process Lab (CS752)

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FM : 50 **Contact Period : 3S**

Laboratory work based on the theory paper CS702

Compiler Design Lab (CS753)

FM : 50 **Contact Period : 2S**

For the programming language and a specific m/c running under UNIX the following experiments are aimed at the design and implementation of a compiler.

1. Familiarization with Lex and development of the scanner for the language.
2. Familiarization with Yacc and development of a parser.
3. Incorporation of an effective error recovery scheme in the parser.
4. Incorporation of action routines for declaration processing and type analysis.
5. Incorporation of action routines for generation of a specific intermediate code.
6. Generation2 of target m/c code from intermediate code.
7. Formalization with optimization and retargetable code generation tools.

Project Preliminaries /Thesis (CS754)

FM-50 **Contact Periods:2S**

To work on a specific project and evaluation on the basis of submitted term paper

Viva-Voce II (CS771)

FM :50 **Contact Periods: Nil**

Viva voce on all theoretical subjects up to present semester

8th Semester - COMPUTER SCIENCE AND TECHNOLOGY

Software Engineering (CS801)

FM : 100 *Contact Period : 3L + 1T*

Introduction, life cycle models, software cost estimation;
Traditional approach to software system development, Requirements engineering, process analysis, macro and micro design, DFD, structure charts etc., system models, user interface design, formal specification;
Verification and validation, software testing and maintenance, software metrics;
Object oriented software design approach;
Project management;
CASE tools, Case study on software development process.
Software Quality Assurance.
Software Configuration Management.

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Symbolic Logic & Artificial Intelligence (CS802)

F M - 100. **Contact Periods : 3L + 1T**

Introduction : Overview and History of A.I..

Problem Solving : Problem Representation in State Space, Production System.

Uninformed Search Strategies – BFS, DFS, Iterative Deepening Search, Space & Time Complexities.

Informed Search – Heuristic Function , Hill Climbing Search, Simulated Annealing Search, Best – First Search, A* Algorithm, Admissibility of A* Algorithm, IDA* Algorithm, Problem Reduction and AO* Algorithm etc.

Constraint Satisfaction Problem.
Means Ends Analysis.

Adversarial Search – Games, The Minimax Algorithm, Evaluation Function, Alpha-Beta Pruning.

Knowledge and Reasoning :
Computational Logic -Review of PL & FOPL ,Automatic Reasoning using Resolution in PL , Skolem Standard Form in FOPL, Clauses and Clausal Forms, Substitution, Unification, General Resolution, Theorem Proving with Resolution, Answer Extraction.

Knowledge Representation – Categories and Objects, Actions, Situations and Events, Situation Calculus, Describing Actions in Situation Calculus, Solving Frame Problem, Knowledge and Belief, Semantic Networks, Reasoning with Default Logic, Open and Close Worlds, Circumscription and Default Logic, Truth Maintenance Systems.

Uncertain Knowledge and Reasoning – Uncertainty , Basic Probability Notation, The Axioms of Probability, Baye's Rule and Its Use, Rule-Based Expert System and Certainty Factor in MYCIN, Dempster- Shaffer Theory for Uncertainty Management.

Making Decisions – Combining Beliefs and Desire Under Uncertainty, The basic Utility Theory, Utility Functions, Multi-attribute Utility Functions, Decision Networks, Decision – Theoretic Expert System, Sequential Decision Problems Value Iteration, Policy Iteration, Decision Theoretic Agents, Game Theory and Nash Equilibrium.

Logic Programming & Prolog :

Conversion of a Clause into Clausal Representation, Logic Programming Concepts, Execution of a Query in Logic Program, General Syntax of Prolog, Prolog Program and Prolog Control Strategy, Relational and Arithmetic Operators, Recursion in Prolog, List Manipulation, Accumulators, The System Predicate 'CUT', Types of CUT, Fail Predicate, CUT and Fail Combination, Negation as Failure, Binary Tree, Binary Search Tree Representations and Operations in Prolog, Implementations of Sorting Algorithms, Representations of Graphs & Problems on Graph in Prolog, Solving A.I. Problems in Prolog.

Machine Learning :

Forms of Learning, Inductive Learning, Learning Decision Trees, Choosing Attribute Tests, Noise and Overfilling, Pruning, Missing Value Treatment, Cost – Sensitive Decision Trees.

Instance – Based Learning – k- Nearest Neighbor Learning, Distance-Weighted Nearest Neighbor Algorithm, Locally Weighted Regression, Radial Basis Functions, Case – Based Reasoning, Lazy and Eager Learning.

Evolutionary Algorithms – Representing Hypothesis, Genetic Operators, Fitness Function and Selection, Hypothesis Space Search, Evolutionary Programming, Models of Evolution and Learning.

Support Vector Machines (SVM) - Maximum Margin, Hyper-planes, Two- Class and Multi-Class SVM, Kernel – Based Methods.

Ensemble Methods - Rationale, Methods for Constructing on Ensemble Classifier, Bias-Variance Decomposition, Bagging, Boosting, etc.

Anamoly Detection - Causes of Anamolies, Approaches, to Anamoly detection.

Assessing and Comparing Learning Algorithms - Holdout Method, Cross- Validation and Re-sampling Methods, Measuring Errors, Interval Estimation, Paired t-test, McNemera's Test, Wilcoxson's Sign Rank Test.

Computational Learning Theory.

Elective III (CS803/X)
(For other departments)

FM: 50 **Contact Periods: 2L**

One of the subjects from the following:

Database Management Techniques in Engg (CS803/1)

Database, Database Management System, Basic Concept of 3-schema architecture, diagram, informal database design, relational data model, relation algebra, Query Language, Security, recovery

Application development : Case Studies

Introduction to Artificial Intellgence and Expert System (CS803/2)

Introduction and Overview,
Search : Production Systems; Concept of State Space; Blind Search: BFS and DFS ; Heuristic Search : Hill Climbing, Simlated Annealing, A* Algorithm, AND-OR Search; Adversary Search : Minimax, α-β Search,
Knowledge Presentation Using Logic : Propositional Logic:
Normal Forms, Resolution; First-Order Predicate Logic :
Terms, Predicates and Quantifiers, Prenex Normal Form,
Skolemization, Clause Form, Unification, Resolution.
Knowledge Representation using Other Techniques : Assumption-Based Truth Maintenance,
Nonmonotonic Reasoning, Semantic Nets and Frames.
Expert Systems : Advantages of Expert Systems, Characteristic of Expert System, Expert System Applications and Domains, Expert System Architecture and Expert System Shells, Design of Expert System
Introduction to PROLOG.

Soft Computing Techniques (CS803/3)

Fundamental Elements of Soft Computing, Fuzzy Sets and Relations, Fuzzy Logic and Approximate Reasoning, Fuzzy Pattern Recognition, Possibilistic Reasoning, Machine Learning Using Neural Nets, Supervised and Unsupervised Neural Learning Algorithms, Competitive Learning Using Neural Nets, Reinforcement Learning, Genetic Algorithms, GA in Optimization Problems, GA for Search and Machine Learning, Genetic Programming, Hybrid Systems : Neuro -Fuzzy, Neuro-GA, Fuzzy-GA, Neuro-Fuzzy-GA.

Design & Management of Information Systems (CS803/4)

Systems concepts – Characteristics, types, boundaries, subsystems, organizational system, information system, systems approach to management, MIS and its role in organization ;
Types and functions of MIS, tools of MIS ; control and feed-back of information systems, feed-forward control ; information quality, information value chain ;
Various models used in information systems especially in MIS such as CSF model, strategic planning model, management control model etc.;

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Basic concepts on design of information systems for MIS oriented applications ;
Decision making process, structured and unstructured decisions, concepts on DSS, ES, KBS etc.;
Socio-technical aspects of MIS.

Elective IV (CS804/X)

FM:100 **Contact Periods: 3L+1T**

One of the subjects from the following:

Mobile Computing (CS804/1)

Infrastructured Wireless Network :

Cellular Network : Introduction, Frequency reuse, Cell design, Cellular architecture, Channel assignment, Hand offs, Location tracking, Load balancing, Query Processing.

Wireless LAN : Overview, Infrared LAN, Spread-spectrum LAN, Narrowband Microwave LAN, IEEE 802 protocol architecture, Medium Access Control, Physical layer.

Infrastructured –less Network : Mobile Ad-Hoc Network(MANET): Architecture, Self organization, Precomputed routing protocol, on-demand routing protocol, location assisted routing protocol.

Sensor Network : Overview, application areas, Sensor nodes, Architecture Data Aggregation, routing.

Image Processing and Analysis (CS804/2)

* Introduction
* Digital Image Definitions
  Common Values, Characteristics of Image Operations, Video Parameters.
* Tools
  Convolution, Properties of Convolution, Fourier Transforms, Properties of Fourier Transforms, Statistics, Contour Representations.
* Perception
  Brightness Sensitivity, Spatial Frequency Sensitivity, Color Sensitivity, Optical Illusions.
* Image Sampling
  Sampling Density for Image Processing, Sampling Density for Image Analysis.
* Noise
  Photon Noise, Thermal Noise, On-chip Electronic Noise, KTC Noise, Amplifier Noise, Quantization Noise.
* Cameras
  Linearity, Sensitivity, SNR, Shading, Pixel Form, Spectral Sensitivity, Shutter Speeds (Integration Time), Readout Rate.
* Displays
  Refresh Rate, Interlacing, Resolution.
* Algorithms
  Histogram-based Operations, Mathematics-based Operations, Convolution-based Operations, Smoothing Operations, Derivative-based Operations, Morphology-based Operations.
* Techniques
  Shading Correction, Basic Enhancement and Restoration Techniques, Segmentation.

Soft Computing Techniques and Applications (CS804/3)

Fundamental Elements of Soft Computing, Fuzzy Sets and Relations, Fuzzy Logic and Approximate Reasoning, Fuzzy Pattern Recognition, Possibilistic Reasoning, Machine Learning Using Neural Nets, Supervised and Unsupervised Neural Learning Algorithms, Competitive Learning Using Neural Nets, Reinforcement Learning, Genetic Algorithms, GA in Optimization Problems, GA for Search and Machine Learning, Genetic Programming, Hybrid Systems : Neuro -Fuzzy, Neuro-GA, Fuzzy-GA, Neuro-Fuzzy-GA.

Real Time Systems Design: (CS804/4)

1) Review of system analysis & Design techniques; State charts, petvi nets & other analysis tools for real time systems.
2) Concept of time, clock skew, delay etc.; Synchronization of clocks through h/w & s/w techniques.
3) Tasks & Their scheduling algorithms for real time environment ; optimality of RM & SDF algorithms, features of real time operating systems.
4) Basics of embedded system design; ASIP design philosophy, Processor architecture variations; memory customization; h/w – s/w partitioning & optimization issues; explorations of architecture; retargetable code generation issues. Micro controllers & other tiny Processors – examples & Application areas.

Symbolic Logic and AI Lab (CS851)

FM:50 **Contact Periods: 3S**

Laboratory exercises based on the theory paper CS802

VLSI Lab (CS852)

FM:50 **Contact Periods: 3S**

Laboratory work based on the theory paper CS704.

Software Engineering Lab (CS853)

FM : 50 **Contact Period : 3S**

Laboratory work based on the subject CS801

Project/Thesis (CS854)

FM:200 **Contact Periods: 6S**

Thesis is to be submitted on the basis of specific project work.

Group Discussion/Seminar (CS855)

FM:50 **Contact Periods: 2S**

Seminar on relevant topics to be delivered

Viva-Voce III (CS871)

FM:100 **Contact Periods: Nil**

Grand Viva voce on all subjects taught during the course.

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DEPARTMENT OF ELECTRICAL ENGINEERING

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APPROVED SYLLABUS for UNDERGRADUATE (B.E.) COURSE

1st & 2nd semester B.E.. Courses

EE 1201 BASIC ELECTRICAL ENGINEERING for all Engg. Branches)

SEMESTER EXAMINATION: **CONTRACT PERIODS: (3 L + I T)**
TIME – 3Hrs. **Continious Assessment :**
Full Marks -70 **Full Marks -30**

Units : SI units of electric and magnetic quantities, relationships among mechanical, electrical and thermal units, dimensions of electric and magnetic quantities. [2L + 1T]

Storage Cell : Rating, charging, capacity & efficiency, maintenance; Maintenance-free batteries, eco-friendly batteries. [2L + 0T]

D.C. Circuits : Node, branch, active & passive elements, linear & non-linear circuits, bilateral network, Kirchhoff's laws, Maxwell's loop current method, star-delta transformation.

Network theorems – Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem. [4L + 3T]

Magnetic Circuits : Magnetic quantities, B-H curve, calculation on magnetic circuits, analogy with electric circuit. [2L + 1T]

A.C. Fundamentals : Sinusoidal quantities, phase & phase difference, average & rms values, form factor & peak factor, concept of phasor diagram, impedance & admittance, power & power factor. [2L + 1T]

A.C. Circuits :

Single-Phase - **series & parallel combinations of R, L & C, phasor diagram, apparent, active & reactive power, series & parallel resonance; applicability of network theorems to A.C. circuits.**
Three-Phase - Balanced system, star and delta connections, phase & line quantities & their relationships, phasor diagram, concept of rotating magnetic field. [6L + 2T]

Transformers : Constructional parts, types, emf equation, phasor diagrams, equivalent circuit, no-load & short circuit tests, losses and efficiency, voltage regulation; Balanced three-phase transformer connections; Auto-transformer. [5L + 2T]

D.C. Machines : Construction and types, emf equation; d.c. motors - back emf, torque equation, characteristic curves of different types of motors, starting & speed control methods, fields of application. [5L + 1T]

Induction Motor : Three-phase Induction Motors – operating principle, types, slip & slip frequency, rotor emf & current, power & torque; Torque-slip characteristic curve, losses & efficiency, starting & speed control methods, fields of application; Classification of single phase Induction Motors and their applications. [4L + 1T]

Measuring Instruments : Classification, torques in indicating instruments; PMMC, Moving Iron & Dynamometer type instruments and their applications as Ammeter, Voltmeter & Wattmeter; Analog & Digital Multimeter. [3L + 0T]

Distribution of Electricity : Conductors & insulators - properties and types of conducting and insulating materials, temperature effect on conductors, insulation resistance of cable, use of Megger. Fuse - materials, fusing factor & characteristics, selection of rating, types of fuses. Electric wiring in small premises, Earthing, Electrical safety, General awareness in electricity conservation. [5L + 2T]

[TOTAL-60L]

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EE 1251 BASIC ELECTRICAL ENGINEERING LAB (for all Engg. Branches)

Full Marks – 50. Contact Periods : (3S)

Laboratory experiments based on the course **Basic Electrical Engineering (EE 1201)**

SYLLABUS F0R 2nd YEAR UG ELECTRICAL ENGG. CLASS (3rd SEMESTER)

Networks and Circuits (EE – 301)

Full Marks – 100 Class : 4L /wk

Review of Basic Circuit Laws. [1L]

Source Transformation, Dependent sources: VCVS, VCCS, CCVS, CCCS [3L]

Application of Network Theorems in AC circuits and for dependent sources: Superposition theorem, Thevenin theorem, Norton theorem, Maximum Power Transfer theorem, Substitution theorem, Compensation theorem, Millman's theorem, Tellegen's theorem. [6L]

Coupled Circuits: Self and Mutual Inductance, coefficient of coupling, connections of coupled coils, Dot convention, modeling of coupled circuits, electrical equivalent of magnetically coupled circuits. [2L]

Complex Frequency and The Laplace Transform: Definitions, Transform of common forcing functions. Derivatives and integrals, shifted functions, Initial and Final Value theorems, Inverse Laplace Transform, Convolution integral, Heaviside Theorem. [8L]

Transient responses of Passive circuits: (Differential equation approach) – RL, RC, RLC circuits with dc and sinusoidal excitation. Locus diagram for series and parallel circuits, Application to transient solution for simple network, time domain analysis by formation of state equations. [6L]

Fourier Analysis: Fourier series, Evaluation of fourier co-efficients, waveform symmetry as related to Fourier co-efficients, Frequency spectrum, convergence in truncated series, Properties of Fourier analysis, shifting function, Exponential form and Trigonometrical form of Fourier series, Line spectrum, steady state responses to periodic signals, aperiodic functions, Fourier Integral and continuous spectra: Spectrum envelope for a recurring Pulse, Fourier Integral and Fourier Transform. [10L]

Two-port Networks: Network elements, Concept of ports and terminals, classification of network, network configuration of network, recurrent network, *Z*, *Y*, *F*, *H* parameters and their interrelationship, Indefinite Admittance Matrix and its applications to the analysis of simple active networks; Condition of reciprocity and symmetry, input and output impedances. Interconnections of 2-port networks, short-circuit and open-circuit impedances, ABCD constants, image impedances, equivalent T- and π- network. [12L]

Networks Functions: Driving Point and Transfer functions and their properties, computing various driving point and transfer functions of standard networks, Concept of Poles & Zeros, Time and Frequency Response of networks, transient and steady state properties, band-width and rise time. [6L]

Electrical Analogous circuits: Mechanical, Thermal, Hydraulic systems etc. [6L]

Total : 60 L

Electrical Measurements-I (EE–302)

Full Marks – 100 Class : 4L /wk

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Review of electrical quantity measuring instrument and classification. General features of electromechanical deflecting type instrument – production of deflecting, controlling and damping torques. [5L]

Detail of various types of indicating instruments – Moving coil, Moving Iron, Dynamometer type, Induction type, Rectifier type, Thermal type and Electrostatic type [12 L]

Extension of Instrument Ranges – Shunts, Multipliers, CTs and PTs. [4L]

CT and PT – Construction, Characteristics, Errors and Testing. [8L]

Measurement of active and reactive power - Dynamometer Wattmeter, poly-phase circuits along with CT/PT connections. [8L]

Integrating type instruments – AC and DC energy meters. [8L]

Low, Medium and high resistance measurement by DC bridges, Megger, Ohm meters, multi-meter and other standard methods [8L]

Localization of Cable Fault. [5L]

Commercially available meters in the present market [2L]

Total : 60 L

Electrical Machines - I (EE-303)

Full Marks – 100 Class : 4L /wk

●**General**

Classification of main types of electrical machines. Faraday's laws and emf generation in different machines. [1L]

Space distribution of flux density and time variation of Voltage. Concept of mmf and flux density distribution in dc and ac machines-uniform dc, pulsating and rotating type. Expression of voltage generated due to rotation of coil in above fields. [5L]

Basic of electromagnetic torque production and concept of torque angle. [2L]

●**DC Machines**

Description of different parts of a dc machine, laminated yoke. Commutation process (brief description) and function of brush commutator assembly. Armature Winding (idea only) [4L]

Principle of operation (motor and generating action), EMF and torque equation. Shunt, series and compound excitation, Magnetisation curve. [4L]

Building up of dc shunt generator. [3L]

Armature reaction (physically). Characteristics of dc generators and motors. Applications [5L]

Methods of starting of dc motors-Three point, Fourpoint starters Methods of speed control of dc motors. [6L]

Transformer

Construction –1ph ad 3ph(Core and shell type). 3 limb and 5-limb construction. Classification of transformers. Basic principle of operation. Concept of ideal transformer. EMF equation. [3L]

Derivation of exact equivalent circuit and its simplification. Phasor diagrams on no load and load at lagging, leading and upf condition. Voltage regulation, maxm voltage regulation and its condition. [7L]

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Losses, efficiency.Efficiency load curve and maximum efficiency condition. Effects of changes of Voltage and frequency on transformer performance. All day efficiency. [4L]

Tests: Polarity test, OC and SC test, separation of iron loss component Sumpner Test. [3L]

Three phase connections (Star-star, deltastar, delta-delta, stardelta, opendelta, zigzag) and vector group [3L]

Harmonics in transformer. Evolution of a three phase, three phase, three limb transformer, Role of independent and interdependent magnetic circuit on performance and unbalanced operation of three phase transformers. [6L]

Parallel operation of transformers. [4L]

Total : 60 L

EE 304 ELECTRICAL MEASURING INSTRUMENTS (for ET)

Semester Examination : Contact Periods : (4L)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

General features, construction and principle of operation of Moving coil, Moving Iron, Dynamometer, Thermal, Rectifier type deflecting Instruments. Simple problems on Deflecting, Controlling and Damping Torques and Expression.

Instrument Transformers, problems,

Measurement of Low, Medium and High resistances, Construction and Uses of Meggers and Multimeters.

Localization of Cable faults.

Potentiometers, Measuring standards.

Measurement of High Voltage, Electrostatic Instruments

Measurement of Inductance, Capacitance and Frequency by A.C. Bridges.

Measurement of power in polyphase circuits, various wattmeter connections, A.C. And D.C. Energy meters.

Introduction to C.R.O. And measurement of phase, frequency and B-H loops etc.

EE 305 ELECTRICAL MACHINES & APPLICATIONS (for CS)

Semester Examination : Contact Periods : (4L)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Transformers : Three phase/six phase, Three phase/two phase (Scott) connection of transformer.

1. Machines : Breaking of d.c. Motors, Losses and efficiency,

Test – Brake test, Swinburne's test, speed control of d.c. Motors using electronic devices.

Breaking of 3 phase induction motors, speed control of 3 phase induction motor – conventional & electronic.

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Single Phase Induction Motor : Construction, classification, Principle of operation. Characteristics.

Single Phase Commutator Motor – Universal motor – principle of operation & characteristics.

Special machines used in computer peripherals.

EE 306 INSTRUMENTATION AND CONTROL (for MT)

Semester Examination : Contact Periods : (4L)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Measurement and sensing of Physical Variable.e.g. Temperature, pressure, flow, strain, thickness, resistivity, moisture, level, displacement; velocity, acceleration, humidity; pH, gas analysis and radioactivity.

Telemetry, Data Acquisition system, Computer aided process instrumentation. Case studies related to this area.

Introduction to control system, Transient and Steady state response, Different types of controllers (P, PI, PD, PID), Programmable Logic Controller.

EE 307 ELECTRO-TECHONOLOGY IN MINING (FOR MN)

Semester Examination : Contact Periods : (4L)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Power distribution : 2-wire & 3-wire D.C. and single phase and 3-phase A.C., overhead and underground systems, earthed neutral Vs. isolated neutral, power factor improvement. Pilot and control circuits.

Under ground cables – types, Installation and jointing, calculation of size of cables. I.S. Specification for mining cables.

Intrinsic safety enclosures for electrical apparatus. Specialties of flame proof machine, I.S. Specification.

Electrical apparatus used in mines- haulages, pumps and working face machineries, Ward Leonard and ILGNER control, SCR control, Electrical signaling. Electro-magnetic and solenoid brakes, safety rules.

Circuit breakers : Oil circuit breakers, Air circuit breakers, Minimum oil circuit breakers, Vacuum circuit breakers, Sulphur Hexa-fluoride (SF6) units.

Electrical layouts of mines.

SESSIONAL PAPERS

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Networks and Measurements -I Lab (EE-351)

Full Marks –100 Class- 4S/Wk

Laboratory experiments based on "Networks and Circuits (EE-301)" and "Electrical Measurements-I (EE–302)"

Electrical Machines -I Lab (EE-352)

Full Marks –50 Class- 4S/Wk

Laboratory experiments based on "Electrical Machines I (EE-303)"

Electrical Installation , Costingand Safety Management Sessional (EE-353)

Full Marks –50 Class- 3S/Wk

Introduction to Utilization of Electrical Equipment: Electrical Appliances (domestic) and their usage; lights, fans, regulators, concept of distribution of LT power in premises and buildings – supply main – metering – mains distribution (panel board, switches, fuse, MCB and isolators, distribution boards) – sub-circuit; electrical earthing. [10S]

Wiring materials: Types of cables and wires, calculation of conductor size, fuse rating; junction box and switchboard and accessories. [8S]

Air-conditioning and Ventilation: Different types of Air-conditioning systems, selection of AC units for different applications – their advantages and disadvantages, calculation of heat-load and refrigeration tonnage (TR.) requirement for different rooms and areas. [10S]

Introduction to Electrical Safety, Safety Management and Electricity Rules: Hazards associated with electricity, physiological effects of electricity - death and injury, safety in electrical installation for residential, small factory and underground location – electrical shock and fire hazards. Case study of accidents due to electrical reasons – accident management including first-aid. [10S]

Preparation of Estimates and Tender Documents: Tender specification for electrical installation works, schedule of rates for electrical items, preparation of electrical layout drawings, costing and estimation, case studies. [12S]

TOTAL: 48S

EE 354 ELECTRICAL MEASURING INSTRUMENTS LAB (for ET)

Full Marks : 50 **Contact Period : (3S)**

Laboratory experiments based on "ELECTRICAL MEASURING INSTRUMENTS (EE-304)"

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EE 355 ELECTRICAL MACHINES & APPLICATIONS LAB (for CS)

Full Marks : 50 **Contact Period : (3S)**

Laboratory experiments based on "Electrical Machines & Application (EE 305)"

EE 356 INSTRUMENTATION & CONTROL LAB (for MT)

Full Marks – 50. **Contact Period :(3S)**

Laboratory work based on "Instrumentation and Control (EE 307)"

EE 357 ELECTRO TECHNOLOGY IN MINING LAB (for MN)

Full Marks : 50 **Contact Period : (2S)**

Laboratory experiments based on "Electro Technology (EE 306)'

SYLLABUS F0R 2nd YEAR UG ELECTRICAL ENGG. CLASS (4th SEMESTER)

Electrical Measurements-II (EE-401)

Full Marks – 100 **Class : 4L /wk**

Measurement errors – analysis, estimation and statistics. [8L]

Potentiometer - DC and AC types [4L]

AC bridges for inductance, capacitance and frequency measurement;Universal bridge. [12L]

Constructions and principles of operation of electrical instruments – phase angle and power factor meter, frequency meter, synchroscope, meters for KWh, KVAh, KVARh, maximum demand indication and measurement – Trivector meter. [8L]

Magnetic Measurement using Ballistic Galvanometer, Flux meter and Hall probes. B-H characteristics of magnetic materials used in Electrical Equipment, Separation of losses. [4L]

Recorders and Plotters – Galvanometric (x-t), Servo (x-y) and magnetic. [2L]

Cathode Ray Oscilloscope and its use in electrical measurement. [6L]

Introduction to Analog and Digital type electric instruments and measurement, [12L]

TOD meters : Solid-state devices for measurement of active and reactive energy. [4L]

Total : 60 L

Electrical Machines-II (EE-402)

Full Marks – 100 Class : 4L/wk

●**General:**
Pitch factor and distribution factor. [2L]

Armature excitation in electrical machines: - Concept of uniform and sinusoidal current sheet. MMF waveforms and their amplitude for dc, ac single phase and poly phase winding. [5L]

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General torque equitation for dc and ac machines. [3L]

●Induction Machine

Construction, Principle of operation [as motor, generated and brake] concept of slip, rotor freq rotor emf. [4L]

Flux-mmf relationship and phasor diagram. Derivation of perphase equivalent circuit, measurement of parameters and performance calculation. Operating characteristics of 3-phase induction motor. Effects of varying V and f on motor performance. [6L]

Torque –slip characteristics and its analysis. [3L]

Circle diagram and its limitations. Prediction of performance from circle diagram [3L]

High torque cage motors –Deep bar and double cage [3L]

NEMA classification. Induction Generator and its application. [3L]

●Transformer

Phase Conversion: 3ph to 2ph, 3ph to 6 ph, 3ph to 12 ph. Grounding transformer, Booster Transformer, in phase and quadrature boosting. [6L]

Three winding transformer. Equivalent circuit [3L]

Induction Regulator [1 ph and 3 ph], rating, uses. [2L]

Voltage Variation by tap changing – on and off load schemes [3L]

Switching in phenomenon of 1 ph and 3 ph transformers [3L]

Autotransformer, Principle of operation, phasor diagram. Comparison of weight, copper loss, equivalent reactance with 2 winding transformer. Welding Transformer [3L]

Tests as per standards and transformer failure. [4L]

●DC Machine Testing

Losses and efficiency. Brake test, Swinburne's Test, Hopkinson's Test. [4L]

Total : 60 L

Field & Circuit Theory (EE- 403)

Full Marks – 100 Class : 4L /wk

FIELD Theory:

Introduction – Physical interpretation of gradient, divergence and curl. The Laplacian operator, vector relationship in Rectangular, cylindrical and spherical polar coordinate systems. [5L]

Electric Field: Potential and potential gradient, Stoke's Theorem, Green's Theorem, Divergence and curl equations. Laplace and Poisson's equation, Helmholtz Theorem, Field equations in different coordinate systems, boundary conditions, dipoles, Continuity equation and relaxation time, Energy Stored due to accumulation of point charges. [6L]

Magnetic Field: Scalar and vector potentials. Divergence and curl of magnetic field. Force and Torque equations. Field equations in different coordinate systems. Boundary conditions, Method of Images. [5L]

Permanent Magnets : Use, second quadrant B-H curve, load line, concept and simple problems.

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Electromagnetic Field: Time varying field and Faraday's law. Displacement current, Maxwell's wave equation. Wave equations in conducting medium. Skin effect. Wave equations in imperfect dielectrics, Maxwell's Field equations vs circuit equations. [5L]

Pointing vector and flow of power. Transmission line analogy. Elements of Electromagnetic fields in Electrical Machines. [3L]

Superconductivity – Elementary concepts, super conducting magnets, super conducting magnetic energy storage. [3L]

CIRCUIT Theory:

Response of networks to Special signal waveforms, Gate functions, Steady state response due to Periodic Excitations, Switching transients and Impulses in networks. [4L]

Elements of Network Topology: Branch, Node, Mesh, Tree, Co-tree, Planer and Non-planer graphs; Incidence, Cut-set, Tie-set matrices; Proof of independent KCL and KVL equations. Network solution by Node basis and Loop basis, Duality, Inverse of a network. [8L]

Elements of Network synthesis: Passivity & Activity criteria of Networks, Routh-Hurwitz stability criterion, Hurwitz polynomials, Positive Real (PR) functions, properties and testing of PR functions, Minimum and non-minimum phase functions. Synthesis of Driving point & Transfer functions of passive networks. Cauer, Foster

syntheses procedures, Lossy network and their synthesis by Cauer and Foster canonical forms. [10L]

Attenuators and Filters: Characteristic and Image impedances, propagation constants, prototype T-section and π-section filters, Low-pass, High-pass, Band-pass, Band-reject filters – analysis and design with reactance diagram, m-derived filters, composite filters, lattice filters. [6L]

Circuit analysis by PSPICE and MATLAB [2L]

Total : 60 L

Solid State Devices and Circuits – I (EE- 404)

Full Marks – 100 Class 4L /wk

Review on Semiconductors, Diodes, BJTs, FETs, Opto-electronic devices & applications. [1L]

Transistors (BJT): Alpha, Beta (forward and reverse biased), Ebers-Moll model. Transistor characteristic curves and parameters (small signal), Biasing circuits, stability factors, phototransistors, opto-couplers, uni-junction transistors. [10L]

Field Effect Transistors: JFET, MOSFET, CMOS, characteristic curves and parameters, Biasing circuits and stability, equivalent circuit and cut-off frequencies. [10L]

Small signal amplifiers: CE, CC, CB amplifiers using BJT (mid frequency operation only) and CS, CD, CG amplifier using FET; Differential amplifiers, common and differential mode gains, CMRR. [8L]

Feedback Amplifiers: Different feedback configurations. [2L]

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Review of Op-amps: Functional blocks; Ideal versus practical op-amp, Feedback amplifier configurations, Adder, sub-tractor, integrator, differentiator and combinations, Voltage to current and current to voltage converters. Comparators, Schmitt triggers, Limiters. [10L]

Digital Circuits : Review of Logic gates, Transistor as a switch, Logic Families- TTL, ECL, CMOS etc., Transfer characteristics, Fan-in, Fan-out, Noise margin, Speed, Propagation delay of gates. [6L]

Review of Boolean algebra and theorems, Combinational Logic Circuits and applications, Minimization of design, MIN-term, MAX-term, SOP, POS, QMC design and K-mapping. [8L]

Circuit Realization: Adder/subtractor, encoder, decoder, code converters, word comparators, parity-bit generator/checker, MUX, DMUX and other applications. Introduction to Latches. [5L]

Total : 60 L.

Numerical Methods and Data Structure (EE- 405)

Full Marks – 100 Class 3L+1T /wk

Numerical Methods:

Solution of Transcendental and Polynomial Equation: Bisection Method, Method of False Position, Newton – Raphson Method, Bairstow's Method for complex roots. [8L+2T]

Solution of Simultaneous algebraic equations: Gauss elimination, Gauss Jordan elimination, L-U factorization, Crout method, Gauss Seidel iteration method [6L+2T]

Interpolation and Curve Fitting: Newton and Lagrange Interpolation Methods, Least Square Regression, Fitting the exponential and trigonometric functions; Newton's forward difference interpolation formula [5L+2T]

Differentiation and Integration: Numerical Differentiation, Numerical Integration, Gaussian Quadrature formula, Simpson's Rule [4L+1T]

Solution of Ordinary Differential Equation: Euler's Method, Taylor's Series, Runge-Kutta Method. [4L+1T]

Numerical Packages: Brief review of standard numerical packages - MATLAB, Mathematica, GNUPlot, GSL, BLAS and others [2L+2T]

Data Structure:

Arrays, Structures and Class in C/C++ - Complex number, vector and matrix [9L+3T]

Stack, recursion, queues, lists and trees [4L+1T]

Data Sorting [3L+1T]

● **Total: 45 L + 15 T**

EE406 **Control & Instrumentation (for CS)**

Semester Examination : Contact Periods : (4L+ 0T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Concepts of Systems : Continuous, Discrete, Fixed, Time- Invariant, Linear, Open Loop & Closed Loop Control System.

Examples of Mechanical Systems, Electrical Analogies

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Concept of Transfer function, Signal flow graph

Excitation and Response of Simple systems, Choice of Input variables, Transient response of SISO Linear Feedback Systems. Improvement of Performance by P,PI, PD, PID control.

Control System Stability-Routh Herwitz criterion, Bode Plot & Roof Locus Method.

Introduction to Instrumentation system and its operation.

Transducers : Displacement, Temperature, Pressure, Flow, Level, Optical Encoder.
Pieso Electric

Instrumentation Circuits and Signal Processing : OP-amps, Instrumentation Amplifier, Signal Generation, Signal Conditioning, Filtering Data Acquisition System & Data Loggers, Opto Isolator

EE 401 A **E L E C T R I C A L S E R V I C E S**

Semester Examination:	**Contact Periods: (2L)**
Time – 3 hrs.	**Internal Assessment:**
Full Marks – 35	**Full marks – 15**

Fundamentals of electricity, current, voltage; Distribution of electric power in towns / cities and house hold connections;

Elements of building wiring system – feeders, panel board, circuit breakers' fuses, switches etc.; Electrical symbols;

Installations from meter board to individual point; Electrical wiring system; Distribution boards and layout of points; Different materials and specification; Earthling agreements; Lighting conductors;

Fixtures and accessories used in electrical installation; Schematic layout of installations and points for different building types;

Methods of lighting; Direct, Indirect, suspended, portable, concealed lighting; Decorative lighting, Flood lighting; Calculation of artificial lighting by various methods.

SESSIONAL PAPERS

Networks & Measurements-II Lab (EE-451)

Full Marks –50 Class- 3S/Wk

Laboratory experiments based on "Field & Circuit Theory (EE-403)" and "Electrical Measurements-II (EE–401)"

Electrical Machines-II Lab-II (EE-452)

Full Marks –50 Class- 4S/Wk

Laboratory experiments based on "Elec Machines -II (EE-402)"

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Data Structure Lab (EE-453)

Full Marks –50 Class- 2S/Wk

Laboratory experiments based on "Numerical Methods and Data Structure (EE-405)"

SYLLABUS F0R 3rd YEAR UG ELECTRICAL ENGG. CLASS (5th SEMESTER)

Electrical Machines-III (EE-501)

Full Marks – 100 Class : 4L /wk

DC Machine:

Armature reaction and its effects, commutation, inter pole and compensating winding, Parallel operation of dc machines, Equaliser convection [5]

Poly phase Induction Machine

Methods of starting for squirrel cage and slip ring motors [3]

Different methods of speed control- voltage control, freq control, and slip power control, resistance and reactance Variation, variation of no of poles, pole amplitude modulation. Kramer and Scherbius method of speed control. [6]

Power factor control [2]

Effect of space harmonics on machine performance. [3]

Tests as per standard [3]

Synchronous Machine

Cylindrical and salient pole rotor construction. Damper winding Principle of operation as motor and generator. [4]

Excitation systems including brush less and static excitation system. [5]

Flux –mmf relationship and armature reaction. Equivalent circuit. Phasor Diagram (Cylindrical rotor). Motor and Generator action. [5]

Steady State Characteristics –External characteristics, Field compounding characteristics, Freq-Active power and Terminal Voltage and Reactive power characteristics. [2]

Effect of varying field excitation and V curves, effect of controlling governor opening. Synchronous condenser and its application. [3]

Determination of parameters of synchronous machine. Separation of Xs into armature reaction and leakage reactance component [3]

Short circuit ratio and its significance [1]

Voltage regulation computation by different methods [3]

Power flow and maximum power [4]

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- **Total: 60 L**

Electrical Power System-I (EE-502)

Full Marks – 100 Class : 4L /wk

Basic structure of power system: Generation, Transmission and Distribution [1L]

Overhead transmission line: Types of conductors, Calculation of line parameters – Inductance and Capacitance of single phase, three phase, symmetrical and unsymmetrical configurations, Concepts of GMD and GMR, Transposition, Bundle conductors, Double or parallel circuit, Effect of earth on capacitance calculation, Interference with communication circuit. [16L]

Performance of lines: Short, medium and long lines - Representation, A, B, C, D constants, Voltage regulation and Transmission efficiency, Ferranti effect. [8L]

Power flow through transmission line: Mathematical expressions, Effect of active and reactive power flow on bus voltage magnitude and phase angle. [3L]

Overhead line insulators: Different types, Voltage distribution, String efficiency, Methods of equalizing potential, Insulator failure. [6L]

Mechanical design of overhead lines: Sag and tension calculations, Effect of ice and wind, Stringing chart, Sag template, Tower design, Spacing and clearance, Vibration damper. [6L]

Underground cables: Different types, Insulating materials, Dielectric stress, Grading, Capacitance, Heating and causes of breakdown. [7L]

Per-unit method of computation: Per-unit quantities, Changing the base of per-unit quantities, Per-unit impedance of single phase and three phase transformers and alternators, Advantages of per-unit method. [8L]

Power system grounding or earthing: Equipment grounding, Neutral grounding – Different methods, Grounding transformer. [5L]

- **Total: 60 L**

Solid State Devices and Circuits – II (EE- 503)

Full Marks – 100 Class : 4L /wk

Advanced Transistor Circuits: Hybrid π- equivalent circuit and high frequency effects, cut off frequency, Multistage amplifiers. Coupling methods, High-Fi amplifiers: Bootstrapping, Darlington combination, current mirror, para-phase amplifier, Trans-conductance multiplier. [10L]

Power amplifiers: class A & B. Q-pt selection, D.C. & A.C. load lines, distortion, O/P power, power dissipation, impedance matching, Transformer-less power amplifiers. [8L]

Electronic power supplies & voltage regulators. [4L]

Special application of Op-Amps: Oscillators and function generators: sine-wave (Wein bridge, Colpitts, Hartley, Phase-shift, quadrature oscillators), square-wave, triangle wave, saw-tooth wave; multi-vibrators, VCO, active filters, PLL, application in instrumentation amplifiers, Logarithmic and antilogarithmic amplifiers [8L]

Data acquisition system: A to D and D to A conversion, Sample/Hold circuit, acquisition time, aperture time, hold time, conversion time; Different types of ADCs and DACs. [4L]

Special Function ICs.: 555Timer, IC voltage regulator, 78xx, 723, SMPS 3524, Switched Capacitance filter, Fiber Optics: Driver, Opto-coupler etc. [6L]

Sequential Logic circuits: Review of Latches, contact de-bouncers, Flip Flops, Memory and storage of binary information; Registers, Buffer and shift registers, Ring counters, Tri-state buffers, Serial to parallel and parallel to serial data conversion, Basic building blocks of digital computers. [10L]

Counter design: up/down, ripple/ synchronous counters, modulo-N counters. [8L]

PSPICE Application. [2L]

Total : 60 L

Control System – I (EE-504)

Full Marks – 100 Class : 4L /wk

Systems – Continuous/Discrete, Time-invariant/Time-varying, Linear/Nonlinear, Open loop/Closed loop, Effects of negative feedback. [2L]

Transfer Functions – (example: R-L-C series circuit or equivalent), Order and type of transfer functions, Block diagram representation of systems (example: d.c. motor or equivalent), Block diagram algebra, Signal Flow graph (Problems as well as Matlab assignments) [9L]

Time and frequency domain specifications, Transient Analysis of standard first and second order systems with unity feedback, Transient and steady state errors – definitions, Error constants. (Problems as well as Matlab assignments) [10L]

Stability: Routh Hurwitz Criteria and Nyquist stability criterion, Relative stability: Siginificance of Gain margin and phase margin, Construction of Root locus, Bode plots and Polar plots, Minimum/Non-minimum phase systems, Transportation lag, Pade approximation. (Problems as well as Matlab assignments) [18L]

Case studies: Effect of P, PI, PD and PID control: Zeigler Nichol's settings, Effects of Lead and lag compensation – time domain and frequency domain analysis, Effect of tacho-generator feedback. (Problems as well as Matlab assignments) [16L]

Control system components: Potentiometers, synchros, Tachogenerators, A.C. and D.C. Servomotors, Gyroscope. [5L]

- **Total: 60L**

Electrical Machine Design (EE-505)

Full Marks – 50 Class : 2L /wk

Principles of Design of Electrical Apparatus: Magnetic, Electrical and Insulating materials used in electrical machines, I.S.S. [8L]

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Heating and Cooling of Electrical Machines; Heat dissipation due to conduction, convection & radiation, types of enclosures, calculation of temperature rise due to thermal action, cooling coefficient, rating of electrical machine for different duty cycle, I.S.S. Different types of cooling medium and estimation of coolant. [7L] Design of magnetic circuits for transformers and rotating machines, Permissible flux densities, Estimation of no-load current, Flux leakage, Leakage reactance for transformer and rotating machines, Flux plotting [5L] Output equation of transformer and rotating machines, specific electric and magnetic loading and their effects on design. Design of winding. [5L]

Main dimensions of transformer and induction motor ; Limiting values of some important design factors and their effects on performance. [3L]

Application of digital computers in design. [5L]

●Total: 30L

SESSIONAL PAPERS

Electrical Machines -III Lab (EE-551)

Full Marks –50 Class- 4S/Wk

Laboratory experiments based on "Electrical Machines -III (EE- 501)"

Solid State Circuits and Control Systems Lab (EE-552)

Full Marks –100 Class- 4S/Wk

Laboratory experiments based on "Solid State Devices And Circuits –I & -II (EE-404 & EE-503)" and "Control System –I (EE–504)"

Electrical Machine Design Ses-I (EE-553)

Full Marks –50 Class- 2S/Wk

Design:
Specification of electrical apparatus as per I.S.S. Selection of equipment for various duty cycles according to I.S.S. Temperature-time curves and estimation of steady state temperature, Effect of altitude on temperature rise.

Design of Transformer (3-Phase & 1-Phase):
Construction, main dimensions, core design, winding design, magnetic circuit and leakage reactance calculations. Designing of tank, cooling tubes, radiators and conservators. Design considerations for protections against surge, transformer accessories, Testing as per I.S.S.

Design of 3 phase induction motor:
Main dimensions,Design of windings and slots, squirrel cage motor bars, skewing, selection of slot combination in squirrel cage motors and its importance. Calculation of equivalent circuit parameters and performance characteristics, Calculations of temperature rise, Design of shaft and selection of bearing, Testing as per I.S.S.

Group Discussion & Seminar (EE-554)

Full Marks – 50 Class : 2S /wk

Each student has to participate in organized group discussion on technical/current / sociological problems as well as in seminars. Close collaboration with industries should be sought in organizing the group discussion.

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Viva Voce-I (EE-571)

Full Marks – 50

The students have to appear in a viva-voce test at the end of the fifth semester course. The test will be based on their theoretical and practical knowledge in the branch of Electrical Engineering.

SYLLABUS F0R 3rd YEAR UG ELECTRICAL ENGG. CLASS (6th SEMESTER)

Electrical Machines-IV (EE-601)

Full Marks – 100 Class : 4L /wk

Synchronous Machines:
Two-reaction theory and phasor diagram, Power Angle Characteristics, Power flow, maximum power, Reluctance power. [10]

Excitation and Power Circles, Synchronizing power, stability, parallel operation of alternators, Operating chart for large alternators. [10]

Automatic Voltage Regulators, Loss of excitation, Prime mover failure, effect of excitation on system dynamics. [5]

Synchronous Induction Motor. [2]

Electrical transients in Synchronous machines: Sudden short ckt, Concept of transient and sub transient reactances, Hunting in synchronous machine, Determining of X_d, X_q, X_1, X_2, X_0, X_d', X_q', X_d'' and X_q''. [8]

Problems during starting and methods of starting, Speed control of synchronous motor. [3]

Single Phase Induction Motor:
Classification, operating principles and characteristics, Double revolving field and cross field Theory, Equivalent circuit and phasor diagram, Expression for starting torque and condition of maximum torque, Determination of parameters of equivalent circuit, Applications. [10]

AC Commutator Machines:
Transformer and rotational emfs in phase and commutator Windings, Scharge motor, characteristics, phasor diagram, Single-phase ac series motor [Uncompensated and compensated], Expression for torque. [8]

Electrical machines in control systems:
DC machines, Cross field Machines, Any current topic on Electrical Machines. [4]

- **Total: 60 L**

Electrical Power System -II (EE-602)

Full Marks – 100 Class : 4L /wk

Interconnected power system: Advantages, Load sharing of generating stations. [2L]

Power circle diagram: Receiving end and sending end power circle diagrams [3L]

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Voltage control: Role of reactive power on voltage and voltage regulation, Voltage control using reactive power compensation - series and shunt compensation, Use of phase modifiers. [6L]

Load frequency or Power frequency (P-f) control and load dispatch: P-f control and its physical concepts, P-f control mechanism and introduction to load dispatch. [6L]

Symmetrical faults: Three phase short circuit on loaded and unloaded alternator, Network reduction technique, Calculation of short circuit KVA, Rupturing capacity of breakers. [8L]

Fuse and circuit breaker: Basic functions of fuse and circuit breaker and their coordination. [3L]

Computer aided short circuit studies: Step-by-step method of development of bus impedance matrix (ZBUS), Fault calculation. [8L]

EHV A.C. and HVDC transmission systems: Introduction to EHV A.C. and HVDC systems, Comparison, HVDC transmission - Power flow in DC links, Control aspect. [6L]

Corona: Corona and its causes, Critical voltage, Corona loss, Reduction of corona loss. [4L]

Power system transients: Transients in EHV A.C. line - Causes, Nature and characteristics of lightning, Impulse test, Switching surge, Strength of insulation and insulation level in EHV A.C. systems, Protection of systems and equipments from transient over voltage, Insulation coordination, Traveling wave phenomenon and Bewley's Lattice diagram. [12L]

- **Total: 60 L**

Control System – II (EE-603)

Full Marks – 100 Class : 4L /wk

Discrete and sampled data control system – definition, Shanon's sampling theorem, Signal Reconstruction, Zero order and first order hold, Z transform, inverse Z transform, Pulse transfer function, Mapping of s-plane to z-plane and vice versa, Convolution and Deconvolution, Jury's stability criterion, Bilinear transformation, Discrete time PID controller. (Problems as well as Matlab assignments) [20L]

State variable analysis of LTI SISO systems- State space (SS) description of continuous time systems (SS model of d.c. motor, RLC networks, Mass-spring-damper systems), State transition matrix, Solution of state equations with impulse and step inputs, Linear transformations, Diagonalisation, Decoupled system, State space to signal flow graph(SFG), Transfer function (with zeros) to state space via SFG, Controllability and Observability: tests, definitions and canonical forms. Controller design based on Linear state variable feedback, Design of full order observers. State space description and SFG representation of discrete time systems. (Problems as well as Matlab assignments) [26L]

Optimal control: Minimisation of performance indices: ISE, IAE, ITAE, Linear Quadratic Regulator: mention problem statement and solution only (derivation excluded). Plant parameter variation, Uncertainty, Sensitivity, Disturbance rejection, Robustness. (Problems as well as Matlab assignments on selected topics) [8L]

Nonlinear control: Characteristics of common nonlinearities, describing functions of common nonlinearities, Phase plane analysis, Lyapunov stability, Popov criterion. (Problems as well as Matlab assignments on selected topics) [6L]

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- **Total: 60 L**

Instrumentation (EE- 604)

Full Marks : 100 Class: 4L /wk

Introduction to instrumentation systems and its operation. [1L]

Sensors and Transducers: Classifications, Transducers for measurement of non-electrical quantities e.g. displacement, velocity, force, acceleration, speed, torque, strain, pressure, level, temperature, Transducers for measuring Electrical quantities, Direct Digital Transducer etc. [13L]

Special Transducers: Electro-analytic transducers, Radioactive transducers, Bio-sensors, Micro and nano-sensors. [6L]

Instrumentation amplifier configurations, Programmable gain amplifier, Isolation amplifier [5L]

Signal Generators: DFG, oscillators, Signal conditioners: level shifters, filters; Signal Processors: precision rectifiers, absolute value circuit, Log, antilog amplifiers, multiplier, squarer, square rooter, RMS and True RMS circuits. [8L]

Central monitoring and Data Acquisition System: Data loggers, Application of microprocessors, Data compression techniques, Regression, Identification techniques, Introduction to Digital Filters and DSPs. [10L]

Supervisory and Distributed control. Actuators and Annunciators, Recorders, Plotters, Display Devices. [5L]

Telemetry: Analog and Digital data transmission, Standards, Current loops, live and dead zero; p-i, i-p converters, modulators and demodulators, RZ, NRZ signals. [6L]

Application of PLCs in instrumentation. [4L]

Typical case studies and related modern topics. [2L]

- **Total : 60 L**

Microprocessor and Interfacing (EE-605)

Full Marks : 100 Class: 4L /wk

Evolution of digital computers using digital electronics. Evolution of microprocessors. Basic building blocks of a microcomputer. Semiconductor memory – volatile & non-volatile buses. Memory addressing capacity of CPU. Classification of computers – Micro, Mini and main frame and their application areas. A Basic Idea about Servers and Workstations. [7L]

Decimal, binary and hexadecimal number systems. Binary addition and subtraction. Representation of negative number – 1's complement and 2's complement. Conversion of hexadecimal to binary and vice versa. Floating point representation of number. ASCII and BCD code. [4L]

Architecture of an 8-bit microprocessor. ALU, registers and control unit. Data and address buses. Demultiplexing address cum data bus. Functions of different pins of the microprocessor. Instruction cycle, machine cycle and timing diagrams for opcode fetch, Memory Read/Write and I/O Read/Write. Machine

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language, assembly language and high level language – specialities and areas of application.
[8L]

Instruction set of a popular 8-bit microprocessor. Addressing modes – direct, register, register, register indirect, immediate and implicit. Status flags and their uses. Mnemonics for – data transfer, arithmetic, logical, branch, stack, I/O and machine control. Stack operations. Subroutine and monitor.
[8L]

Examples of assembly language programming. Addition of binary and decimal numbers. Finding square from look up table. Finding largest/smallest number in a data array. Arranging data array in ascending/descending order. Sum of a series of binary/decimal numbers. Multiplication and division programs. Multibyte addition and subtraction. Time delay etc.; Use of Assembly Language to interface Programmable Peripheral Devices with Microprocessor [12L]

Basic principles of different modes of data transfer – synchronous, asynchronous, interrupt and DMA.
[5L]

Programmable peripheral interface – building blocks, control word formation for simple I/O and BSR modes. Interfacing DAC and ADC with microprocessor. Some simple application of microprocessors in embedded systems. [8L]

A brief introduction of 8086 Microprocessor Architecture and 8051 microcontroller architecture

[8L]

- **Total : 60 L**

SESSIONAL PAPERS

Electrical Machines and Power System Lab (EE-651)

Full Marks –100 Class- 4S/Wk

Laboratory experiments based on “Electrical Machines-IV(EE-601)” and “Power System–II (EE–602)”

Control System and μP Lab (EE-652)

Full Marks –100 Class- 4S/Wk

Laboratory experiments based on “Control System–II (EE-603)” and “μP & Interfacing (EE-605) ”

Electrical Machine Design Ses-II (EE-653)

- Full Marks : 50 Class: 3S /wk

Any **two** of the following

a) Design of DC machines: Main dimension, winding, Commutator, field winding and brush graph.

b) Design of non-salient pole rotor of synchronous machine; main dimension, Winding Design, damper winding.

c) Design of salient pole rotor of synchronous machine; Main dimension, design of pole dampers winding & Field winding.

d) Design of single-phase induction motor: Main dimensions, starting & main winding design, performance calculation.

Industrial Visit and/or Survey Camp (EE-671)

Full Marks : 50 Class: 15 days

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The objective of this paper is to familiarize the students with the industrial environment, first hand experience on use of different types of electrical equipment used in engineering industries. The visit will be preferably 15 days duration in any reputed organization during winter recess (at the end of 5th semester).

The students have to submit a report to the department followed by a presentation and viva-voce.

Viva Voce-II (EE-672)

Full Marks – 50

The students have to appear in a viva-voce test at the end of the sixth semester course. The test will be based on their theoretical and practical knowledge in the branch of Electrical Engineering.

SYLLABUS F0R 4th YEAR UG ELECTRICAL ENGG. CLASS (7th SEMESTER)

Electrical Power System-III (EE-701)

●Full Marks : 100 Class : 4L/wk

Load flow analysis: Basic concepts, Bus admittance matrix (YBUS), Different methods of load flow – Gauss-Seidel method, Newton-Raphson method, Fast Decoupled method, DC load flow method, Comparison; Contingency analysis. [12L]

Symmetrical components: Fortsecue's components, Sequence impedances of static and rotating machines, Phase shift in star-delta transformer banks, Positive, Negative and Zero sequence networks, Three winding tie transformer. [7L]

Unsymmetrical fault: Types of fault, Single-line to ground fault, Line to line fault and Double line to ground fault. [5L]

Sensing elements: Current transformer (CT), Potential transformer (PT), Capacitor voltage transformer (CVT), Phasor diagram, Errors and their determination from test, Specialties of protective CTs and PTs, Polarity, Connection, Saturation, I.S. Specification, Special measuring elements. [6L]

Protective relaying: Functions and functional characteristics, Primary and back-up relaying, Different elements in a typical power system protection scheme, Terms and definitions; Types of relay - Electromagnetic induction and attraction, Overcurrent, Overvoltage, Directional and directional overcurrent, Characteristics. [12L]

Economic operation: Distribution of load between units within a plant, Transmission loss as a function of plant generation, Distribution of load between plants. [5L]

Power system stability: Steady state, transient and dynamic stability, Stability limits, Dynamics of synchronous machine and swing equation, Equal area criteria, Critical clearing angle and critical clearing time, Solution of swing equation, Factors affecting different types of stability, Stability improvements. [10L]

Modern trends in power system design and operation. [3L]

●Total: 60 L

Industrial Power Electronics (EE-702)

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Full Marks : 100 Class : 4L/wk

Solid State Devices for Power Control: Power Diodes & DIAC – construction and switching characteristics. BJT's, Power MOSFET's & IGBT's – their drive circuits, static and dynamic characteristics. Four layer devices like – TRIAC, SCR, GTO, IGCT etc. operation and switching characteristics, Isolation and

synchronization of driving pulses, Triggering and commutation schemes for SCR. Requirement & design of switching aid circuits; Cooling. [10L]

Uncontrolled & Controlled Rectifier circuits (single phase and three phase) – Voltage output, power output, Transformer Utilisation Factor, Ripple Factor, Power Factor, Selection of rating of devices. Use of freewheeling Diodes. Effect of source and load inductances. Control strategies. Filter requirement. [10L]

AC Voltage Controller (single phase only) : Integral cycle control, Phase control, their applications – transformer tap changer. [4L]

DC Chopper – Classification, principles, design, analysis and uses. [8L]

Inverters – Principles and different topologies of single phase and three phase bridge and PWM inverters. Commutation process for thyristorised inverters. Selection of circuit parameters. Methods of voltage and frequency control. Reduction of harmonics. VSI & CSI. [8L]

Cycloconverter – Principle, types, single and three phase circuits, uses. [4L]

Power Supplies – Principles, different topologies and uses of SMPS, UPS and CVT [4L]

Industrial Applications:

DC Drives: Speed control of dc motors using power electronic circuits. Steady state and transient analysis of open loop and close loop controlled DC motor using converters/choppers. [4L]

AC Drives – Stator voltage control and PWM control of three phase induction motors. Closed loop control principles and block schematics. [4L]

Welding, Induction Heating, HVDC transmission, Electronic Ballast. [4L]

- **Total: 60 L**

Digital Signal Processor and Embedded Systems (EE-703)

- Full Marks : 100 Class : 4L/wk

Digital signal processors:

Architecture of Digital Signal Processors	[3L]
DSP Processor vs Conventional Processor	[1L]
Fixed Point Arithmetic vs Floating Point Arithmetic	[1L]
DSP for Embedded Systems	[4L]
DFT and FFT Implementation, Designing filters(FIR and IIR Filters),Windowing	[9L]
DSP programming in MATLAB/Assembly Language	[6L]
Applications of DSP in Speech Processing, Measurement systems, Drives etc.	[2L]
Networking Essentials and Protocols, IEEE standards	[4L]

Embedded Systems:

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Embedded System Architecture [2L]

Overview of Embedded Controllers (Microcontrollers like 8051, 80196 etc.) [3L]

Programmable Logic Devices : Concepts of PLA, PAL and FPGA's, CPLD's - Types, Architecture, Basic Design Process. [9L]

Xilinx / Altera solutions and case studies. [3L]

Embedded Software Development Tools - Introduction to VHDL language basics. Modelling combinational and sequential logic systems. Simulation and testing. [7L]

JTAG Development and Debugging Support. [2L]

Introduction to Cross Compilers and RTOS [2L]

Security Issues with Embedded Systems [2L]

●Total : 60 L

Power System Planning (EE-704)

Full Marks : 50 Class : 3L/wk

Introduction to Power System, Inter Connected System. Power Scenaris at a Glance.

Typical Power Generation, Transmission and distribution Scheme. Block, diagram of the System Network, Electrical Connection diagram. OAD curve, significance of load curve, Spining reserve base load plant, Peak load plant, Types of Generation – Thermal,Hydro, Nuclear, Gasturbine, Wind power & Hybrid types etc. Types of Consumer i.e. Domestic, Commercial, Industrial and Agricultural etc.

Load Forecast, Typical regression curves in power system load fore casting, Estimation of Connected load, Load characteristics, its nature and type, sensitive load, dirty load. Estimation of demand . Concept of maximum Demand, Diversity factor, Availability Factor, Plant Load factor, Capacity factor etc. Utilization Factor.

Tariff – Different types of Power demand (VA watt, VAR), metering method, Block rate, flat rate two part, T.O.D. tariff. Availability Base Tariff (ABT).

Restructing of Power System Structure, Electricity Act.

Substation : Different types, role of Sub-Stn.

Bus bar – Strain & rigid type, Different types of busbar arrangement – Single, Main & Transfer Bus, Duplicate busbar, Breaker & a half, Ring Main System, Three bus Scheme, Bus-Tie operation.

Secondary Distribution System : Different types of Distributor, Efficiency, Different types of feeding of D.C. And A.C. distribution system, Current loading and voltage drop diagram. Difference between feeder & distributor.

Energy economics & Power Factor Improvement : Objective, Consumer of different types of power, series and shunt capacitors, sizing and location of capacitor, Effect of flow of reactive power, Remedial action –

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Economical & Technical Advantages Location of the device to be installed. Rural electrification.

- **Total: 45 L**

Elective-I (Dept) (EE-705/x) **

Illumination Engineering (EE705/1)

●**Full Marks : 100** **Class : 4L/wk**

Sources of light : Day light , artificial light source; energy radiation , visible spectrum of radiation, black body radiation and full radiator. [8L]

Incandescence , dependence of light o/p on temperature. Theory of gas discharge and production of light. [8L]

Perception of light and colour, optical system of human eye, eye as visual processor . Reflection, refraction and other behaviours of light [8L]

Measurement of light – radiometric and photometric quantities and their units of measurement . Standardization, measurement of light distribution , direct & diffused reflection, fundamental concept of colorimeters and measurement of color. [12L]

Types of lamps: GLS Tungsten –halogen, Discharge, low pressure sodium vapour, high pressure sodium mercury vapour , fluorescent, Metal- halide , IR and UV lamps, their construction , filament material , theory of operation , life , characteristics and application Xenon Lamps, LED lamps, Fibre Optic and Laser Lighting [10L]

Design objectives and specification of lighting & system design of luminaire their electrical circuits and auxiliaries . Basic lighting design consideration and lighting parameters for exterior lighting , interior lighting and day lighting [10L]

Energy conservation in lighting

A Case Study with Lighting design Software to learn an optimized design approach [4L]

- **Total: 60 L**

Power Station Practice (EE-705/2)

Full Marks : 100 **Class : 4L/WK**

Introduction: One line diagram of different cycles. Single line electrical layout diagram of Switchyard, Generators, Transformers, Bus bars, Feeder bays, Main bus, Transfer bus, Bus coupler, Bus tie, Bus bar operations with merits and demerits. [8L]

Alternator – Active and reactive power control, Capability curve, under and over excitation control, choice of excitation system, synchronization, Power System Stabiliser and its role towards power system dynamics, Rotor and stator temperature monitoring, cooling and Hydrogen pressure control, rating of alternator, significance of Short Circuit Ratio, present and future trend in alternator design. [16L]

Process Control and Instrmentation: Types of control and instrumentation in generating station viz combustion control, total Air control, Drum Level control, Furnace Draught control, Deaerator control, Heater control, Superheater Temperature control etc. [5L]

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Different types of Electrical control panels : Electrical Control room, unit control room, local control room, their instruments and protection interlock, .. Annunciation system , Generator-Transformer-feeder protection interlock, Bus duct. [7L]

Plant Auxiliaries: Switch Gear, Motor Control Centers, auxiliaries, their ratings, location, interlock, Cooling Water pump house, Intake pump house, Auxiliary Cooling Water Pump. Ash water pump, Boiler Feed Pump, I.D. fan F/D Fan, Primary Air Fan, Mill motor interlock etc.

Cooling System: Direct and indirect cooling, size and requirements , DM Plant [4L]

Ash Handling System: , Electrostatic Precipitator, duty, requirements. [5L]

Coal Handling Plant – Control room, crusher room, conveying arrangement. [4L]

Testing & Commissioning : Routine test and pre commissioning test of Transformer, Generator, motor etc. [4L]

Start up- Shut down and maintenance. [2L]

● **Total : 60L**

Renewable and New Energy : Sources and Utilization (EE-705/3)

Full Marks : 100 **Class : 4L/wk**

Introduction: Concept of energy, energy situation and conversion to electrical form, energy and society, energy and environment, necessity of non-conventional and renewable energy. [2L]

Solar energy: Solar radiation and its characteristics, Solar radiation records, green house effects, Solar collector:- flat plate, focusing, thermal device, thermo-ionic and thermoelectric conversion, photo chemical conversion, space and water heating, ocean thermal energy conversion. Solar power plant. [14L]

Wind energy: Potential, development of wind turbines, wind electric system, wind pump, utilization and national scenario. [8 L]

Microhydel energy: Potential, development of micro hydro-electric generators & auxiliaries. Non conventional [tidal, wave] hydro electric conversion system. [5L]

Nuclear energy and environment: Review of conventional and nuclear power plant, nuclear fusion reactor, description of existing models, safety and hazards of nuclear energy. [6L]

Magnetohydrodynamics energy conversion: Concept, present and future concept, economic and environmental aspects of MHD generator plant. [4L]

Bioenergy: Resources and conversion process- biogas conversion, biogas plant, present gasifires and bio gas plants used in India. [8L]

Other Energy: Fuel cell; case study, electric and hybrid vehicles, space vehicles. [8L]

Rural energy security: Hybrid system of renewable energy sources- necessity, implementation, national policy. [5L]

- **Total: 60 L**

* Elective-II (Dept) (EE-706/x) **

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[the list of Elective II subjects will be announced in due course]**

SESSIONAL PAPERS

●Power Electroniocs and Instrumentation Lab (EE-751)

Full Marks –100 **Class- 4S/Wk**

Laboratory experiments based on "Industrial Power Electronics (EE-702)" and "Instrumentation(EE-604) "

●Power System and Planning Sess (EE-752)

Full Marks –50 **Class- 2S/Wk**

Laboratory experiments based on "Power System Planning(EE-704)"

Elective-II Lab (EE-753/x)

Full Marks –50 **Class- 3S/Wk**

Laboratory experiments based on "Elective-II(EE-706/x)"

Project Prelim (EE-754)

Full Marks –50 Class- 3S/Wk

Each candidate or a group will be assigned a problem in Electrical Engineering on which the candidate(s) will carry out detailed review/study and/or analysis. He/She will submit a brief report and present his/her /their work in an open defence at the end of the semester.

Industrial Training and Report (EE-771)

Full Marks : 50 **Class: 30 days**

The of this paper is to give the students as exposure to the Industrial and modern practices used is Electrical Engineering Industries. They have to undergo the practical training in a reputed industry during summer vacation at the end of 6th semester preferably for a period of one month. The students have to submit a report to the department duly signed along with the certificate from the competent authority of the concerned organization.

The students have to deliver a seminar talk followed by viva voce on training to be evaluated by the faculty members of the department.

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Viva Voce-III (EE-772)

Full Marks – 50

The students have to appear in a viva-voce test at the end of the seventh semester course. The test will be based on their theoretical and practical knowledge in the branch of Electrical Engineering.

SYLLABUS F0R 4th YEAR UG ELECTRICAL ENGG. CLASS (8th SEMESTER)

Utilisation of Elec Power (EE-801)

- **Full Marks : 50** **Class : 3L/wk**

Traction- System of Track electrification, Train movement & energy consumption (speed-time curves, crest speed , average speed & schedule speed), Tractive effort , Factors affecting energy consumption (dead weight, acceleration weight & adhesion weight) Protective devices; Outlining the concept and use of SCADA in railways and Automatic Train Protection Sub-systems(ATP) [6L]

Electric Traction motor & their control , starting, braking ----special emphasis on power electronic controllers, current collector. Interference with telecommunication circuit. A brief outline of Linear Induction Motor Principle in Traction. [6L]

Illumination – Laws of illumination , polar curves , photometry , integrating sphere Types of Lamps, Basic principle of light control , Different lighting scheme & their design Factory, Flood and street lighting . [8L]

Heating – Types of heating , resistance heating , induction heating, arc furnace, dielectric heating. [4L] Welding – Resistance welding , arc welding, ultrasonic welding , electron beam welding , Laser beam welding , Requirement for good welding , power supplies for different welding. [4L]

- **Total=28L**

Switch Gear & Protective Relaying (EE-802)

- **Full Marks : 100** **Class : 4L**

Differential Relaying : Principles of Differential and percentage differential relaying [3L]

Distance Relaying : Impedance, modified impedance, angloe impedance, reactance and admittance relaying – their characteristics and uses; Pilot relaying-Wire pilot, circulating current and opposed voltage types, carrier current and microwaves pilots. [10L]

Generator protection : General Differential, Loss of Excitation, Low Forward Power Protection, Negative Sequence Protection, Rotor Earth Fault Protection etc. [7L]

Transformer Protection : Transformer Differential, Incipient Fault, Over Fluxing Protection, Transformer Earth Fault Protection etc. [6L]

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L.T. and H.T. Motor Protection (Large and medium size motors), Different Types of Protection – Differential Short Circuit, Overload, Locked rotor, Bi-metal overload relay, DC Motor Protection etc. [6L]

Capacitor Bank and Reactor Protection : Short Circuit, Over Current, Differentia, Earth Fault Protection etc. [3L]

Busbar/Back up protection : Differential, Back up Protection etc. [2L]

Static Relaying : Introduction, advantages, disadvantages, amplitude and phase comparators, level detector, common electronic circuits and their developments etc. [5L]

Numerical Relaying : Fundamental Principal of Operation of Numerical/Digital Relaying advantage and disadvantages, signal conditioning and their applications, modern trends etc. [5L]

Switch Gear : Circuit interrupting devices – isolators and circuit breakers. The arc. Characteristics, mechanism of arc extinction, recovery and restriking voltage, current chopping, breaking of capacitive current. Air, Oil, ABCB, Vacuum Circuit breaker, SF6 – Rating, Selection & Testing of Circuit breaker, HDVC circuit breaker. [9L]

Tests : Laboratory, commissioning and regular maintenance tests on relays and associated elements. [4L]

- **Total : 60 L**

Special Machines and Drives (EE-803)

●**Full Marks : 100** **Class : 4L**

Hysteresis Motors: Construction, operating principle, characteristics & uses. [2L]

Stepper Motors: Construction, type, operating principle, characteristics, drive circuits & uses. [5L]

Switched Reluctance Motors: Construction, type, operating principle, characteristics, drive requirements, drive circuits, control strategies & uses. [6L]

Permanent Magnet Motors: Construction, type, suitable materials for magnet, operating principle, characteristics & uses. [5L]

Brushless DC Motors: Construction, operating principle, characteristics, driving circuits, control strategies & uses. [6L]

Concept of drives: Group drives, multi-motor drives, direct drives. Factors for performance analysis of drives. [2L]

Speed-torque characteristics of different electric drives and various ty6pes of loads. Four quadrant operation of dc and ac drives. [6L]

Speed control: Review of conventional methods of speed control of dc and ac motors and their implementation with power electronic circuits. [6L]

Braking: Regenerative, dynamic and counter-current/plugging of dc and ac motors, their characteristics and their implementation with power electronic circuits. [8L]

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Transient analysis: dynamic behaviour of dc and ac drives under starting and braking condition. Estimation of transient time, speed variation, current variation during starting/braking operations. Energy consumption in transient process and methods for its reduction. [10L]

Applications of drives in some specific industries e.g. textile mill, cement mill, rolling mill etc. [4L]

●**Total : 60 L**

Elective-III (Dept & NonDept) (EE-804/x)

Electricity Conservation and Environment (EE-804/1)

●**Full Marks : 50** **Class : 2L/wk**

Introduction : Concept of energy, energy situation and conversion to electrical form, energy and society, Review of Conventional and Non-Conventional Energy Sources and their potential, Electrical energy generation/ Consumption/ utilization pattern.

Type, Nature and characteristics arising out of usage, atmospheric pollution (air, water, noise, radiation). [8L]

Source of Pollution: Industry wise pollutants, pollution from power generating stations/ sources. [4L]

Environmental Analysis: Environmental change, ecosystem, resource depletion, climatic effects, Land use - Government action and Environmental Organization. [8L]

Improvement in Electrical Energy utilization : Concept of energy efficiency of electrical appliances. Installation, repair and general maintenance of appliances for efficiency improvement. Development of methodology, [10L]

Conservation Methods : In transmission and distribution, electric power drives, traction, lighting, heating, refrigeration and air conditioning, agricultural appliances. [10L]

Energy Planning and Management : General awareness, energy policy and planning, economics of energy management, instrument for auditing, electrical energy audit, case studies. [5L]

TOTAL :[45L]

Elective-IV (Dept) (EE-805/x)

High Voltage Engineering (EE 805/1)

●**Full Marks : 100** **Class : 3L /wk**

Electro-static Fields – Calculations and experimental determination [8L]

Studies of High Voltage phenomenon in solid, liquid and gas with applications to high voltage cables and machines. [6L]

Production and measurement of Direct, Alternating and Impulse voltage. [6L]

Theory and operation of Impulse Generators [4L]

Characteristics of high voltage testing transformer [4L]

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Breakdown phenomena in solid, liquid and gas [6L]

Dielectric Polarization and Polarization Index, Partial Discharge Phenomenon. [6L]

High voltage testing of Dielectrics, Insulators. [6L]

Transformers and cables; lighting phenomena and protection. [6L]

Basic impulse insulation level, Insulation Co-ordination. [4L]

Topics of Current Interests with Industrial Relevance [4L]

●Total : 60 L

Process Control Instrumentation (EE-805/2)

FM – 100 **Class- 3L/wk**

Introduction to some terminologies related to a process control such as a) Balanced condition,b) self regulation, c) process time lag, d) process disturbance, e) process reaction curves. [2L]

A typical control system with measuring means, error detector, amplifier, controller, final control elements. [1L]

Realisation of control actions, (P, PI, PD and PID) using pneumatic (Motion Balance and Force Balance type) , hydraulic, electronic principles. [8L]

Brief studies on Cascade and Ratio control. [2L]

Dynamics of fluid flow (turbulent), fluidic devices. [4L]

Actuators and Control valves. [6L]

Review of commonly available transducers. Sensing of process variable like flow, humidity, viscosity, pH. Sensors using Gas Analysis. [14L]

Application of transducers in process control. [3L]

Review of computer aided process instrumentation (DCS, DDC). [2L]

Relay Ladder Diagram, Control System Flowcharting, PLC and its programming. [5L]

Instrumentation in different process industries like power plant, cement, paper, steel and allied, leather, polymer. [13L] **Total: 60 L**

Energy Audit and Management (EE 805/3)

●Full Marks : 100 **Class : 3L**

Introduction : Energy – concept, sources & availability, situation, conversion, energy and society, energy and environment, energy analysis and potential in nation, energy utilization and identification of conservation in different sections. [6L]

Energy Audit : Objective, systems, boundary definitions, types of auditing. [5L]

Organization : Methodology finalization, sources of numerical data, instruments required, precautions, tests carried out, presentation. [7L]

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Forecasting and Energy Conservation : Technological forecasting methodology of electrical energy demand, institutional role of energy conservation, related case studies. [8L]

Improvement in Energy utilization : Review of energy efficiency and the improvement of - electrical appliances and mechanical devices, generation, transmission and distribution. [14L]

Case Studies of energy audit : Power plant, metallurgical industry, local electrical distribution network, office/shopping complex and residential colony. [15L]

Policy and implementation : National planning and policy, awareness - general, industry and rural user, analysis of previous audit report. [5L]

TOTAL : 60L

SESSIONAL PAPERS

Inddustrial Electronics & Drives Lab (EE-851)

Full Marks –100 **Class- 4S/Wk**

Laboratory experiments based on "Industrial Power Electronics (EE-702)" and "Special Machines & Drives (EE-803)"

Prot. Relay Lab (EE-852)

Full Marks –50 **Class- 2S/Wk**

Laboratory experiments based on "Switch Gear & Protective Relaying (EE-802)"

Elective-IV Lab (EE-853/x)

Full Marks –50 **Class- 2S/Wk**

Laboratory experiments based on "Elective-IV(EE-805/x)"

Project & Thesis (EE-854)

Full Marks –150 **Class- 5S/Wk**

The sessional work will consist of planning and/or design and/or development of software programs and/or construction, and/or experimentation on problems in any major field or fields of Electrical Engineering. The candidate should work either alone or in groups as assigned by the the department in the 7th semester under PROJECT PRELIMINARIES. Each group will submit two copies of dissertations in typed and bound form. The thesis will embody the results of work, keeping in mind the standard specifications and codes of practices used in the profession. Thesis work should include also the review work and further theoretical/experimental/simulation based studies. The purpose of this sessional is to intimate the candidate into realm of critical study so as to develop his mind. Emphasis should be given to fundamental scientific approach to the solution rather than an empirical approach.

Viva Voce-IV (EE-871)

Full Marks – 50

The students have to appear in a viva-voce test at the end of the eigth semester course. The test will be based on their theoretical and practical knowledge in the branch of Electrical Engineering.

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

APPROVED SYLLABUS for UNDERGRADUATE (B.E.) COURSE

1st & 2nd semester B.E. Courses

ET 1201 **BASIC ELECTRONICS ENGINEERING** **(for all Engg. Branches)**

SEMESTER EXAMINATION:	**CONTRACT PERIODS: (3 L + I T)**
TIME – 3Hrs.	**Continuous Assessment :**
Full Marks -70	**Full Marks -30**

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Review of passive components-Types, characteristic and application Energy Bands in conductor, insulator and semiconductor.

Semiconductor properties, pn junction avalanche diode,zener diode-their applications as rectifier, voltage doublers and waveshaping power supply Bipolar junction transistors- biasing, characteristic, different mode of operation.

Use of BJT as amplifier, signal stage amplifier, power amplifier, feedback amplifier.Oscillator –RC.LC, Crystal type, Multivibrators.

Field effect transistor- types, configuration, characteristic and use as amplifier.

Elements of opto electronics devices-LED, LCD, LDR, Photodetectors.
Principles of fiber optic communication.

Elements of power electronics devices.

Operation amplifier and its application,

Boolean function and logic gates.

Introduction to analog and digital ics.

Cathode ray oscilloscope, use of analog and digital multimeter.

ET 1251 BASIC ELECTRONICS ENGINEERING LAB (for all Engg. Branches)

Full Marks – 50. Contact Periods : (3S)

Following experiments based on the course **Basic Electronic Engineering (ET 1201) :**

1. Familiarization with electronic component and measurement using multimeter
2. Familiarization with function generator and use of CRO for various waveform measurement.
3. Experiment with DC power supply
4. Experiment with (a) Characteristics of transistors and (b) Characteristics amplifiers
5. use of 741 as (a) amplifier, (b) adder, (c) integrator
6. Realization of logic functions using 7400and7402.

(ET 301) SIGNALS AND SYSTEMS
(3L+1T)/WEEK FULL MARKS-100

Signals and systems, classification and representation of signals, concepts of linear vector space and orthogonal signal representation, Fourier transform, generalized Fourier transform. Signal distortion in transmission, distortionless conditions. LTI system, Impulse response, convolution, transfer function, discrete signals and systems, sampling, digitization and reconstruction of analog signals. Random signals and their properties, thermal and shot noise, auto and

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cross-correlation, power spectral density, random variables and processes, classification, system response to random signals, functions of random signals, state representation. Hilbert transform and its properties. Pre-envelope, canonical representation of bandpass signals, concept of complex envelope.

Text Books/ References: 1) Signals & Systems - Oppenheim,Willisky & Nawab
2) Signals & Systems – Simon Haykin
3) Signals Systems & Communication-B.P.Lathi
4) Communication Systems- Carlson

(ET 302) NETWORK THEORY
(3L+1T)/ WEEK FULL MARKS-100

Network components and characterization, transformation of sources. Graph theory: Loop and nodal analysis, tie-set and cut-set matrices, formulation of network equations, solutions of equations. Transient and steady state response of RL, RC and RLC series and parallel circuits using Laplace transforms; network equations and solutions with initial conditions, initial and final value theorems; unit step, impulse, ramp functions; Laplace transform for shifted and singular functions, convolution integral. Resonance: Series and parallel, Q-factor, BW. Bode plots. Network theorems: Transform impedance and admittance, series and parallel combination; Thevenin, Norton, superposition, Millmann, reciprocity, compensation, telegene's theorems. Network functions; Driving point and transfer functions, concept of poles and zeros, one port network, two-port network parameters, restriction on poles and zeros in s-plane, time-domain behaviour from pole-zero plot. Elements of network synthesis: Hurwitz polynomial, real and reactive functions, synthesis of RL, RC, LC networks.

Text Books/References:
1.Network analysis- Van Valkenburg
2. Network analysis- Mithal
3. Networks and systems-A. Hussain
4. Networks and systems- Roy Choudhury

(ET 303) ELECTRONIC DEVICES
(3L+1T)/ WEEK FULL MARKS-100

Electron as a classical particle, principles of electron emission; E-B diagram, there use in defining and classifying Semiconductors, Type of semiconductors, example of Semiconductors, with application areas. Relations determining fermi-level and carrier concentration in conductors and semiconductors, introduction to E-K diagrams, concept of effective mass of a carrier .Use of E-K diagram in classifying semiconductors & degenerate semiconductors. P-N junction, drift and diff phenomenon, diff potential, depletion region & approximation, result of forward and reverse biasing, fabrication of homojunction, heterojunction & schottky barriers. Bipolar junction transistors, structures, current gain, current-voltage characteristics, BJT models, Punch-through and Breakdown, High-frequency equivalent circuits, Transient analysis. Metal-semiconductor junctions-Schottky and Ohomic contacts, JFETs and MESFETs-simple

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analysis, Equivalent circuits, MOS capacitors, CV characteristics, Threshold voltage, Flat-band voltage, MOSFETs, I-V relationship, Equivalent circuits, Short channel effects, MOSFET structures, CMOS, P-N-P-N diodes, SCRs, LEDs and photo detectors, UJT, Special semiconductor Devices-Gunn diode, Tunnel diode, varacter, IMPATT.

Text Books/References:

1) Electronic Devices & Circuits- Boylestead & Nasalsky
2) Solid State Electronics Devices- Streetman, Banerjee
3) Electronics Engg. Materials & Devices-J.Allison
4) Semiconductor Devices-J.Singh

(ET 304) ANALOG ELECTRONICS

(3L+1T)/ WEEK FULL MARKS-100

Familiarity with electronic components and devices. Semiconductor diode circuits: static and dynamic resistance, clipper and clamper circuit. Zener diode and its equivalent, voltage stabilization. Schottky diode, light emitting diode, their characteristics. Transistor circuit fundamentals: construction and basic operation of transistors, CB, CE and CC configurations, characteristic curves and current gain. Transistor biasing- base bias, emitter bias, collector bias, stability factor, thermal runway and bias compensation. Small signal amplifier: equivalent circuit (h and r parameters), current and voltage gain, input and output impedance. Multistage amplifiers: RC coupled, transformer coupled and direct coupled amplifier and there frequency responses. Non-sinusoidal waveform: Integration and differentiation using RC and RL circuits. Step response to RLC circuits. Power amplifier: working principle, class A, class B and class C amplifiers, efficiency, harmonic distortion. Push pull, transformer coupled and complementary symmetry amplifiers. Tuned voltage amplifier: single ended and double ended type, frequency response. Feedback amplifier: concept of feedback, types of feedback, and voltage amplifier with negative feedback, emitter follower circuit. Oscillator: damped and undamped oscillation, different types of oscillation, positive feedback amplifier, barkhausen criterion, tuned collector, Hartley, Colpitt, Clap, RC phase-shift, Wien bridge and crystal oscillator, multi vibrators: astable, monostable, bistable. Voltage and current time base circuit. Synchronization technique.

Text Books/References:

1) Electronic Devices-Floyd
2) Electronic Devices & Circuits-Mottershead
3) Electronic Principles-Malvino
4) Electronic Fundaments & Applications-Ryder
5) Integrated Electronics-Millman & Halkis
6) Pulse Digital and Switching Waveforms – Millman & Taub

(ET 351) NETWORK THEORY LAB

3 HOURS/WEEK FULL MARKS-50

Experiments of this laboratory are based on NETWORK THEORY (ET 302).

(ET 352) ELECTRONIC DEVICES AND CIRCUITS LAB

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4 HOURS/WEEK FULL MARKS-100

Experiments of this laboratory are based on ELECTRONIC DEVICES (ET 303) and ANALOG ELECTRONICS (ET 304).

(ET 401) ANALOG COMMUNICATION

(3L+1T)/ WEEK FULL MARKS-100

Introduction to communication systems, signals and spectra, RF spectrum and usage. Concept of modulation, necessity of modulation. Principles of linear modulation and demodulation: AM, AM/DSB, AM/SSB, AM/VSB, AM/ISB; circuits for linear modulators and demodulators. Angle modulation and demodulation: FM, PM; circuits for angle modulators and demodulators. Pulse modulation: Sampling, pulse modulation and detection of PAM, PWM, PPM. Multiplexing: FDM, TDM. Transmitting systems: AM, FM transmitters, neutralization, cooling, shielding arrangements. Radio receivers: Super-heterodyne; AGC, AFC, PLL and their applications; receiver characteristics and testing, space and frequency diversity reception. Noise: Atmospheric, thermal, shot noise; noise figure, noise temperature, noise bandwidth; SNR performance of AM, FM, pulse modulation systems.

Text Books/References:

1. Electronic communication system- Kennedy
2. Radio Engineering – Mithal
3. Modern digital & analog comm. systems- Lathi
4. Principles of communication system-Taub, Schilling

(ET 402) DIGITAL ELECTRONICS

(3L+1T)/WEEK FULL MARKS-100

Number systems, Number representation and codes, Switching algebra and Boolean functions, minimizing functions using maps. Basic gate structures – TTL, ECL, MOS, CMOS. Combinational logic circuits: Gate level combinational logic design, positive/negative logic convention, direct polarity indication, arithmetic functions-binary adders, carry look ahead adder, binary subtracter, encoders, decoders, multiplexers, demultiplexers, implementing logic functions using – multiplexers, decoders, PROM, PAL etc. Sequential logic circuits: introduction to a sequential machine-state transmission diagrams and state transmission tables, Latches and flip-flops, memory elements, shift registers, counters, sequential adders.

Text Books/References:

1) Digital Integrated Electronics- Taub & Schilling
2) Digital Design-Mano
3) Computer Arithmatic-Hwang
4) Digital Design: Principle & Practice- Wakerly

(ET 403) MICROELECTRONICS

(3L+1T)/WEEK FULL MARKS-100

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An introduction to integrated circuits, IC materials, preparation of single crystal silicon, Czocharlsky technique, Ore refining technique, Purification of crystals, Wafer preparation, Doping of impurities in silicon, Impurity diffusion-predeposition and drive-in, Fick's law, Diffusion equations, Dopant redistribution, Oxidation techniques, Oxide properties, Oxide characterization, pattern generation and transfer, various lithographic techniques, photoresists, Resist development, Exposure of resists, Mask alignment techniques; Etching of Silicon, silicon dioxide, Etch process, Wet and dry etching, Isotropic and anisotroic etching, lift-off technique. Metallization of ICs, Materials choice, physical vapour deposition , Sputtering Metallization equipments, Deposition of dielectric materials, chemical vapour deposition reactors and process, Plasma deposition and etching, RF/magnetron sputtering, Bipolar/MOS IC process sequence, An introduction to BIMOS/BICMOS process. Fabrication of low cost thin film semiconductors by Spray Pyrolysis (SP), chemical bath, electrolysis and electro deposition, GaAs wafers by epitaxial groth-LPE, VPE& MBE, GaAs HEMT & MMIC fabrication.Ion beam and plasma deposition processes, Ion implantation, post annealing , channeling, Ion sources and various system components. Multi chip modules-basic concepts, MCM vs other packaging technologies, via structures, Micro-electromechanical systems(MEMS).

Text Books/References:

1) Microelectronic Devices- D.Nagchowdhury
2) Microelectronic Processing-W.Scot Ruska

(ET 404) ELECTROMAGNETIC THEORY AND RADIO WAVE PROPAGATION

(3L+1T)/WEEK FULL MARKS-100

Review of vector analysis: Gradient, divergence, curl, stokes and divergence theorems. Electrostatics: Coulomb's law, Gauss's law and their applications, potential, Poisson's and Laplace equations and their applications, capacitance, dielectrics, dipoles, electrostatic energy, uniqueness theorem, boundary conditions. Steady current: Current density, ohm's law, continuity equation. Magnetostatics: Biot-Savart law, Ampere's law and their applications, magnetic dipole, vector potential, magnetic material, magnetostatic energy, boundary conditions. Maxwell's equations: Time varying electric and magnetic fields, electromagnetic induction, Faraday's law and application, displacement current, Maxwell's equations in integral and point form. Uniform plane wave: Equation and its solution, plane wave propagation in insulator and conductor, skin depth, reflection and refraction of plane waves, pointing theorem. Radio wave propagation: Different mode of radio wave propagation, surface wave, space wave, tropospheric duct propagation, troposcatter propagation, ionospheric propagation, magneto ionic theory, secant law, MUF, critical frequency, skip distance and zone.

Text Books/References:

1. Electromagnetics- Kraus
2. Electromagnetic waves and radiating systems-Jordan & Balmain
3. Elements of electromagnetics-Sadiku
4. Engineering electromagnetics-Hayt

(ET 405) NUMERICAL ANALYSIS AND COMPUTER PROGRAMMING

(3L)/WEEK FULL MARKS-100

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Overview of C programming, Array and string, User defined function, Structure and Union, Pointers, File Management, Dynamic memory allocation, Link List, low level programming with C.
Concept of numerical analysis, numerical interpolation for polynomial, numerical differentiation method, numerical integration method-trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule.
Solution of differential equation: Successive Approximation Method, Eulers method, Runge Kutta Method, Predictor corrector method, Method for curve fitting, matrix inversion, eigen value, eigen vector, software for all the above methods.

Text Books/References:
1) Introductory Methods of Numerical Analysis- Sastry
2) C Programming Language-Gottfried
3) Application Programming in C-R.S.Salaria

(ET 451) ANALOG COMMUNICATION LAB
3 HOURS/WEEK FULL MARKS-50

Experiments of this laboratory are based on ANALOG COMMUNICATION (ET 401).

(ET 452) DIGITAL ELECTRONICS LAB
3 HOURS/WEEK FULL MARKS-50

Experiments of this laboratory are based on DIGITAL ELECTRONICS (ET 402)

(ET 453) MICROELECTRONICS LAB
3 HOURS/WEEK FULL MARKS-50

Experiments of this laboratory are based on MICROELECTRONICS (ET 403)

(ET 454) NUMERICAL ANALYSIS & COMPUTER PROGRAMMING LAB
3 HOURS/WEEK FULL MARKS-50

Experiments of this laboratory are based on NUMERICAL ANALYSIS & COMPUTER PROGRAMMING (ET 405).

(ET 501) DIGITAL COMMUNICATION
(3L+1T)/WEEK FULL MARKS-100

Digital representation of signals. Advantages of digital transmission. Elements of digital communication, linear and nonlinear quantization. PCM, Log-PCM, DM, ADM/ DPCM and LPC for speech signals. Time division multiplexing, ITU (T) and AT&T multiplexing standards; channel mode, base band transmission, Digital modulation techniques – ASK, FSK, PSK. Binary and M-ary signaling techniques & their spectra. Carrier and clock synchronization, Optimum detection, matched filter, Optimum terminal filters, ISI and its control. Line codes and their Power Spectral Density (PSI), Error Correcting Codes: Block codes, Definitions, Generator and parity check matrix, error

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control capability, standard array, cyclic codes, description, encoding with an (n-k) stage shift register and (a-k) stage shift register, syndrome calculations and error detection.
Elements of information theory, discrete and continuous messages, channels with and without memory. Concept and measure of information. Self-information, Average information. Entropy, information rate, joint and conditional entropies. Mutual information channel capacity. Redundancy and efficiency, BSC, BEC & noisy channels. Shannon Hartley law and its implication.
Spread Spectrum Techniques: Wideband codes & their correlation properties, DS & FH techniques, use of spread spectrum in code division multiple accesses.

Text Books/References:

1) Digital Communication- Simon Haykin
2) Principles of Communication Systems –Taub & Schilling
3) Digital & Analog Communication Systems-Leon W.Couch
4) Digital Communication- Proakis

(ET 502) INTEGRATED CIRCUITS AND SYSTEMS

(3L+1T)/WEEK FULL MARKS-100

Basic operational amplifier: Structure, parameters and their measurement, frequency and step response. Applications: differential amplifier, electronic analog computation, active filter, delay equalizer, tuned and cascode amplifier, comparator, sample and hold circuit, precision AC/DC converters, logarithmic amplifier, waveform generator and Schmitt trigger. Integrated circuit timer. Programmable Logic Array (PLA) and Field Programmable Gate Array (FPGA). Concept of Application Specific Integrated Circuit (ASIC).
CMOS Logic Structure: pseudo-nMOS logic, Dynamic CMOS logic, CMOS domino logic, pass transistor logic.
Semiconductor Memories: MOS Registers, RAM, ROM, CCD.
Mixed analog-digital circuits: D/A and A/D converters.
Digital System Design: multiplier, divider, floating point arithmetic processor etc.

Text Books/References:

1) Digital Integrated Electronics-Taub & Schilling
2) Analysis & Design of Analog Integrated Circuits-Gray & Meyer
3) Integrated Electronics-Millman & Halkias
4) Computer Arithmetic-Hwang

(ET 503) MICROPROCESSOR

(3L)/WEEK FULL MARKS-100

Evolution of digital computer, evolution of microprocessor. Microprocessor architecture: 8-bit (e.g. 8085) and 16-bit (e.g. 8086/8088). Addressing modes of microprocessors, instruction set of 8-bit (8085) and 16-bit microprocessors (8086/8088). Instruction cycle, timing diagram. Subroutine, assembly language and machine language programming. Types of memories and their organizations (RAM, ROM, stack, secondary etc.). Interrupt, DMA, principle of data transfer (synchronous and asynchronous). Serial data communication, RS-232 standard. Peripheral interface: PPI, DMA controller, interrupt controller, programmable timer, CRT controller, USART.

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Text Books/References:

1. Microprocessor architecture, programming and application with the 8085- Gaonkar
2. Fundamentals of microprocessors and microcomputers- B. Ram
3. 8086/8088 family (Design, programming & inteface)- Uffenbeck
4. 8088 & 8086 microprocessors (Programming, interfacing, software, hardware and application)- Triebel & Singh

(ET 504)TRANSMISSION LINES AND WAVE GUIDES

(3L+1T)/WEEK FULL MARKS-100

Transmission Lines: Transmission line equations and their solutions. Line parameters, characteristic impedance, input impedance, distortion less line, phase and group velocity. Line terminated by arbitrary load, reflection, and standing wave pattern. Transmission line matching, quarter wave transformer, single and double stub tuners. Smith chart: theory and application. Telephone line and cable, radio frequency line, resonant and anti resonant line, Q of resonant line. Lossy line. Tapered transmission line. Slotted line measurements at radio frequency. Time domain reflectrometry. Non-uniform transmission lines.
Wave Guide**:** parallel plane wave-guide: TE and TM waves in wave guides, their transmission properties and attenuation. Transmission line analog of wave-guide. Wave guide resonator, loaded and unloaded Q. Dielectric slab waveguide. Microstrip lines.

Text Books/References:

1) Electromagnetic Wave & Radiating Systems-Jordan
2) Networks Lines & Fields-Ryder
3) Elements of Electromagnetics-Sadiku

(ET 505)ELECTRONIC MEASUREMENT AND INSTRUMENTATION

(3L)/WEEK FULL MARKS-100

Definition of different measuring parameters, classification of instrument, various measurement technique, measurement and error. Statistical methods in experimental measurements, modeling of instruments. Electromechanical indicating instruments. Universal Bridge. Electronic measurements for measuring basic parameters: True RMS voltmeter, electronic multimeter, digital voltmeter, Q

meter etc. Oscilloscopes: cathode ray tube and circuits, probes, oscilloscope measurement techniques, storage oscilloscope. Signal generator: frequency synthesizer. Signal analysis: Wave analyzer, harmonic distortion analyzer, and spectrum analyzer. Electron microscope. Transducer: various type of transducer & its measurement technique, e.g., measurement of strain, displacement, velocity, acceleration, force, torque, pressure, temperature etc. Noise measurement. Guarding and shielding electronics associated with digital measuring systems. Fiber optic measurements. IEEE 488 electrical interface.

Text Books/References:

1) Modern Electronic Instrumentation & Measurement- Helfrick & Cooper
2) Electronic Instrumentation & Measurement- A.W.Sahany

3) Principle of Industrial Instrumentation-Patranabis
4) Electronic Instrumentation- Kalsi

(ET 506) DATA STRUCTURE AND COMPUTER ORGANIZATION

(3L)/WEEK FULL MARKS-100

Data Structure

Basic concept, static and dynamic structures: stacks, queues

Searching: Sequential and binary searching, sorting: merge sort, quick sort.
Tables-hash, symbol.
List: storage reclamalies, multilink structures
Trees: Binary trees.

Computer Organization

An overview of Computer organization, basic structure, description of functional blocks. Data representation, Fixed, floating and decimal arithmetic. Fast adders, Fast multipliers, integer division, floating point operation. Microprocessor design considerations: concepts of instruction cycle, addressing modes, interrupts, interfacing with peripheral devices and their characteristics. RISC and CISC processors with their applications. Design examples of arithmetic and control unit, using hardware and microprogrammed approaches, modification of the design for RISC architecture. Memory organization: Caches, Multiprogramming and time sharing. Virtual memory concept.

(ET 551) DIGITAL COMMUNICATION LAB

3 HOURS/WEEK FULL MARKS-50

Experiments of this laboratory are based on DIGITAL COMMUNICATION (ET 501).

(ET 552) INTEGRATED CIRCUITS & SYSTEMS LAB

3 HOURS/WEEK FULL MARKS-50

Experiments of this laboratory are based on INTEGRATED CIRCUITS & SYSTEMS (ET 502).

(ET 553) MICROPROCESSORS LAB

2 HOURS/WEEK FULL MARKS-50

Experiments of this laboratory are based on MICROPROCESSORS (ET 503)

(ET 554) TRANSMISSION LINE & WAVEGUIDE LAB

3 HOURS/WEEK FULL MARKS-50

Experiments of this laboratory are based on TRANSMISSION LINE & WAVEGUIDE (ET 504).

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(ET 555) ELECTRONIC MEASUREMENT AND INSTRUMENTATION LAB

3 HOURS/WEEK FULL MARKS-50

Experiments of this laboratory are based on ELECTRONIC MEASUREMENT AND INSTRUMENTATION (ET 505).

(ET 571) VIVA VOCE I

(Full Marks:50)

A viva voce test for the students will be taken at the end of 5th semester to evaluate their depth of knowledge and level of understanding of different subjects studied by them in first five semester in this field of engineering.

(ET 601) MICROWAVE AND RADAR ENGG.

(3L+1T)/WEEK FULL MARKS-100

Microwave generation and amplification: two-cavity klystron, reflex Klystron, magnetron, TWT amplifier, solid state parametric amplifier, tunnel diode amplifier and oscillator, Gunn oscillator, IMPATT, TRAPATT and BARITT oscillators, MASER. Microwave passive components: adaptor, attenuator, directional coupler, tee, Wave meter, circulator, filter, TR and ATR cells. Microwave communication system: L.O.S. system, tropo-scatter system, satellite system. Microwave heating, applications. Microwave measurement: attenuation, frequency, power, V.S.W.R. , Q and noise figure. MMIC, MIC- Microstrip. RADAR ENGG. : Range equation, pulsed radar, CW Doppler radar. Pulse Doppler radar, search and tracking radar. Electronic counter measures: active jammer, electronic intelligence receiver(ELINT).

Text Books/References:

1) Microwave Devices & Circuits- S.Liao
2) Microwave :Introduction to circuits devices & Antennas-Sisodia & Gupta
3) Radar Handbook-Skolnik
4) Microwave Engineering-R.Chatterjee

(ET 602) ADVANCED MICROPROCESSORS & COMPUTER ARCHITECTURE

(3L)/WEEK FULL MARKS-100

Introduction to advanced microprocessors (32 bit & 64 bit), Multi-user, Multitasking operating system concept. Architecture of advanced microprocessors 80286, 80386 & 80486. Memory management system, Protected mode of operation, Introduction to Pentium microprocessor. Introduction to micro controller architecture, programming and application. Microcomputer system peripherals: Magnetic disk, Optical disk, printer mechanism & interfacing.

Evaluation of modern computer architecture, Basic architectural classification. Introduction to parallel processing. Parallel computer structure. Principles of pipelining and vector processing. Pipeline computers. SIMD array processors. Multiprocessor architecture.

Text Books/References:

1) Microprocessor & Interfacing- Hall
2) Intel Microprocessors- Brey
3) The Pentium Microprocessor- Antonakos
4) Computer Architecture & Parallel Processing- Hwang & Briggs

(ET 603) SYSTEM SOFTWARE

(3L)/WEEK FULL MARKS-100

Introduction to software design of a basic computing system. Assembler: addressing schemes, different type of instructions, Multipass assemblers, Macro assemblers. Loader, Linker. Compiler design: elementary definitions, lexical and syntax analyzer, code optimizer and code-generator. An overview of operating system. CPU scheduling algorithms. Process management, main memory management, virtual memory management, secondary memory management. Deadlock. Case studies: DOS, UNIX and other modern operating systems.

Text Books/Refereences:

1) Operating Systems Concepts- A.Silberschatz & P.B.Galvin
2) Operating Systems-A design oriented approach-Crowley
3) Introducing Unix System V- R.Morgan
4) Fundamental Concepts of Programming Systems-Ullman

(ET 604) AUDIO AND VIDEO ENGINEERING

(3L)/WEEK FULL MARKS-100

Electrical analog acoustical system, Loudspeakers, Microphones.
Tape recording and reproduction, Fidelity and stereophonic systems, introduction and design of recording studio, reverberation and measurement of reverberation time.
Compact disk, IC chips for audio applications. Telephone hand set, telegraph instruments, teleprinter, telex, FAX, E-mail.
Analysis and synthesis of picture, scanning processes, camera tubes, composite video signals, video amplification methods, compensation and D.C. restoration.
Amplitude Modulation, vestigial sideband transmission, Television transmission, TV transmitter. The transmitter-receiver relations, overall system response.
Block diagram of TV receiver, receiving antennas, picture tubes, IF section, video detector, AGC, synchronization separator. Deflection systems, horizontal, AFC, Power supplies, Extra high voltage generation, High voltage safety IC chips for TV applications, introduction to TV servicing. Fundamental of colour transmission, introduction to different systems of colour TV. Introduction to multimedia systems.

Text Books/References

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1) Monochrome & colour television - Gulati
2) Audio Video System- Gupta

(ET 605) ANTENNA ENGINEERING

(3L+1T)/WEEK FULL MARKS-100

Oscillating dipole: electromagnetic radiation, retarding potential. Antenna parameters: directivity, beam width, gain, radiation resistance, polarization, and effective height. Short dipole, thin linear antenna, loop antenna, long wire antenna, rhombic antenna. Antenna array: broadside and end fire array. Pattern multiplication, ground proximity effect, two and three-dimensional arrays. Array pattern synthesis: binomial array, Tchebyshev array. Broad band antenna: Yagi Uda array. Log periodic array, discone and helical antenna, trunstile antenna. Aperture antenna, Babinet's principle. Microwave antenna: Open wave guide, horn, parabolic reflector and its feed, cassegrain antenna, wave guide slot array, lens antenna. Microstrip patch antenna. Smart antenna. Receiving antenna: reciprocity theorem, effective aperture. Friss transmission formula, antenna noise temperature.

Text Books/References:

1) Antennas –Krauss
2) Antennas & Radiowaves Propagation-Collin
3) Electromagnetic Waves & Radiating Systems-Jordan

(ET 651) MICROWAVE AND RADAR ENGINEERING LAB

3 HOURS PER WEEK(FULL MARKS :50)

Experiment of this laboratory are based on Microwave and Radar Engineering(ET 601)

(ET 652) ADVANCED MICROPROCESSORS LAB.

3 HOURS PER WEEK (FULL MARKS: 50)

Experiments of this laboratory are based on ADVANCED MICROPROCESSORS & COMPUTER ARCHITECTURE(ETC 602) .

(ET 653) SYSTEMS SOFTWARE LAB

3 HOURS PER WEEK(FULL MARKS :50)

Experiments of this subject are based on SYSTEMS SOFTWARE (ETC –603)

(ET 654) AUDIO AND VIDEO ENGINEERING LAB

3 Hours per week (Full Marks : 100)

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Experiment of this laboratory are based AUDIO AND VIDEO ENGINEERING (ET 604)

(ET 655) GR. DISCUSSION/SEMINAR
2 HOURS/WEEK FULL MARKS-50

In this sessions students will participate in an organized group discussion on a topic relevant to any technical subject or any contemporary social issue and also in seminar on a topic of a similar nature. The objective of this session is to augment the communicative skill of the students. An assessment of their ability will be made at the end of 6th Semester.

(ET 671) VIVA VOCE II
(Full Marks:50)

A viva voce test for the students will be taken at the end of 6th semester to evaluate their depth of knowledge and level of understanding of different subjects studied by them in first three years in this field of engineering.

(ET 701) POWER ELECTRONICS
(3L+1T)/WEEK FULL MARKS-100

Power semiconductor devices: power semiconductor diode, power BJT, power MOSFET, IGBT, FCT, MCT. Thyristor: characteristics, types, performance parameters, series and parallel operation, thyristor firing circuits. Protection of devices and circuits: snubber circuit, protection against transient voltage and current, diode circuits and rectifiers. Thyristor commutation techniques. Controlled rectifiers, single phase and three phase Converters, static switch, AC voltage controller, DC chopper and inverter, DC motor drives.
Adjustable Speed AC Motor Drives: Voltage power inverters. The current power and current regulated types of inverters. The phase controlled cycloconverter. The load committed inverter. Adjustable speed drives using wound rotor induction motor. Adjustable speed drives using synchronous motor.
Vector control of AC motor Drives**:** Uninterrupted Power Supply, Electric Utility Applications, Electromagnetic interface.

Text Books/References:

1) Power Electronics- Rashid
2) Power Electronics- S.N.Biswas
3) Power Electronics Converters Application- Mohan

(ET 702) CONTROL SYSTEMS
(3L+1T)/WEEK FULL MARKS-100

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Mathematical model of physical systems: differential equation and transfer function, state space variable transfer function and state equation. Characteristic of closed loop system. Performance of control system: first order system, second order system, steady error performance. Stability of linear systems, Routh-Hurwitz criterion. Root locus method: Principle and properties. Frequency response plot: Bode plot, transfer function from frequency response, stability from frequency response. Design and compensation of control system: PID controller. Digital control: stability and frequency response of discrete time systems. Non-linear systems: common non-linearity, describing function analysis, Lyapunov's method of stability analysis.

Text Books/References:

1) Automatic Control System-Kuo
2) Modern Control Engineering- Ogata
3) Control System Engineering- Gopal, Nagrath

(ET 703) ELECTRONIC DESIGN AUTOMATION

(3L+1T)/WEEK FULL MARKS-100

Introduction to electronic system representation. Behavioral representation, structural representation, and physical representation: HDL, SPICE. MOS transistor theory. Lay out design rule. Circuit characterization and performance estimation. Design strategies for VLSI processors, high level design, logic design, different delay models, logic simulation, static and dynamic hazards, logic synthesis, and circuit synthesis.

Text Books/References

1) Designer guide to VHDL-Ashenden
2) VHDL-Perry
3) VHDL: analysis and modeling of digital system-Navabi
4) Synopsis CAD tool Manual

(ET 704) DIGITAL SIGNAL PROCESSING

(3L+1T)/WEEK FULL MARKS-100

Introduction to digital signal processing. Elementary discrete time signals, Discrete time systems, input output relation, difference equations, Z-transform and its properties. Filter structures and realizations, Linear phase filters, FIR filter design techniques, IIR filters, IIR filter design techniques, Introduction to multirate filters, computation of the DFT, DCT and WHT. The FFT, mixed radix algorithm, simulation of digital filters, Hardware implementation, Effects of finite register length, Digital Signal Processors , Discrete random signals, discrete correlation, Estimation of power spectral density, Application of digital signal processing.

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Text Books/References:

1) Digital Signal Processing – S.K. Mitra
2) Digital Signal Processing – Proakis & Manolakis
3) Discrete Time Signal Processing- Oppenheim & Schafer
4) Theory and application of DSP- Rabinar, Gold

(ET 705) WIRELESS AND MOBILE COMMUNICATION

(3L+1T)/WEEK FULL MARKS-100

Radio communication principles. Radio wave propagation.- HF, VHF,UHF and microwave propagation. Multipath scattering and signal fading; Modulators and Demodulators, Mixers, Carrier synchronization.
Geostationary communication satellities. Transponders, satellite and earth station transmitters and receivers, Link budget calculations, Multiple Access techniques-FDMA, TDMA, CDMA, SPADE, VSATs. Non geostationary satellites for communications- LEO,MEO.
Mobile Communications: Principles, systems, standards and diversity systems. Cellular mobile communication concepts, principles systems, standards and diversity systems. Multiple access and coding in wireless communication. Various standards. Mobile satellite communications, Personal communication series. IC's for wireless communication. Wireless computing and data communications.
Text Books/References:

1) Wireless digital Communication-K. Feher
2) Mobile Communication Engineering- W.C.Y.Lee
3) Cellular Radio- Asha Mehrota

(ET 706/d) ELECTIVE I

(3L+1T)/WEEK FULL MARKS-100

List and subject contents are given under the heading ELECTIVE SUBJECTS

(ET 751) POWER ELECTRONICS AND CONTROL SYSTEM LAB

3 HOURS PER WEEK(FULL MARKS :100)

Experiment of this subject are based on 1) POWER ELECTRONICS (ET 701) 2) CONTROL SYSTEMS(ET 702)

(ET 752) ELECTRONIC DESIGN AUTOMATION LAB

3 Hours per week (Full Marks : 50)

Experiment of this laboratory are based on ELECTRONIC DESIGN AUTOMATION(ET 703).

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(ET 753) DIGITAL SIGNAL PROCESSING LAB

3 HOURS PER WEEK(FULL MARKS :50)

Experiments of this subject are based on DIGITAL SIGNAL PROCESSING (ET 704).

(ET 754) PROJECT PRELIMINERIES

2 HOURS/WEEK. FULL MARKS-50.

In the 7th semester students normally in groups of three or four will be assigned a project work on an appropriate topic related to this branch of engineering. All the groups will carry out a review work on the project topic, prepare a report and give an oral presentation of this introductory studies.

(ET 771) VIVA VOCE III

(Full Marks:50)

A viva voce test for the students will be taken at the end of 7th semester to evaluate their depth of knowledge and level of understanding of different subjects studied by them in first seven semester in this field of engineering.

(ET 801) OPTO-ELECTRONICS AND OPTICAL COMMUNICATION

(3L+1T)/WEEK FULL MARKS-100

Electromagnetic & opto electronic spectrum categories of Photonic devices.
LASERS-Fundamental conditions, population invention, fabry Perot Cavity He-Ne, carbon dioxide, Ruby lasers, specialty of three and four level lasers, Nd-YAG lasers, quantum well lasers, SH, DH and QW lasers, optical and carrier confinement, threshold current, exercises.
LED's: Principle of IL devices, LED as display element, basic font. LED's in fiber optic communication –edge &surface Emitter LEDs.Ternary alloys.

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Principle of Photovoltaic Conversion, solar cells, categories and examples, V-I characteristics and equivalent circuit, Radiation damage to space solar cells and remedies.
Liquid crystal devices : characteristics & merits as display element, material science aspects.
Photodetectors: categories and examples, intrinsic and extrinsic photodetectors, spectral response, responsivety, quantum efficiency, long wave-length cut off, NEP & detectivity & meter relations. Principle of operation of P-I-N and APD's infrared photodiodes, IR sensors.
Fiber Optic Communication:-Ray theory of light propagation, acceptance angle, numerical aperture & normalized frequency, type of fiber optic cables. Single and multimode fibers, Modal and chromatic dispersion, wave-length division multiplexing, system parameters of interest, components.
Opto Couplers: Different configuration, Parameters and their measurement, Applications.

Text Books/References:

1) Optical Fiber Communication- J. Senior
2) Optical Fiber Communication- Keiser
3) Optoelectronics Engineering- S.N.Biswas

(ET 802) COMPUTER NETWORK AND COMMUNICATION

(3L+1T)/WEEK FULL MARKS-100

Transmission media, data transmission circuit, packet and message switching techniques, network topologies; wide, metropolitan and local area networks. Layered network architecture, network protocols, network interfaces and standards-modems, RS 232C, RS 449, X.25, IEEE 802 and other current standards, ISDN and B-ISDN, switched networks-ATM, Network performance.

Text Books/References:

1) Computer Networks-Tanenbum
2) Data Communication, Computer Networks and Open systems-Fred Halsall
3) Computer network and data communication- Stallings
4) ATM Networks: concepts, protocols, applications- R Handell, M.N.Huber & S. Schroder.

(ET 803) TELECOMMUNICATION SWITCHING

(3L+1T)/WEEK FULL MARKS-100

Introduction to telecommunication switching systems.
Electro-mechanical switching :Strowjer switching systems, crossbar-switching systems, electronic space division switching, line division switching etc. Different types of telephone network, high speed and bridged local area network-ethernet switching. Architecture of HUB, switch and router.
Difference among HUB switch and router, structural difference between general processor and HUB, switch and router. Application of HUB, switch and router in LAN, routing algorithm, traffic engineering, distribution of traffic, internetworking. Data network- different types of public network,

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integrated services digital network-user interface, main features of private integrated voice and data network..

Text Books/References:

1) Telecommunication switching system & network- Viswanathan
2) The Switch Book: Complete guide to LAN switching technology- Seifert, Rich
3) CCNP Cisco LAN switch configuration study guide- Todd
4) Web switching for security availability and speed- Scot Hall

(ET 804/d) ELECTIVE II(Dept.)

(3L+1T)/WEEK FULL MARKS-100

List and subject contents are given under the heading ELECTIVE SUBJECTS

(ET 805/d) ELECTIVE III (For Non-Dept. students)

(2L)/WEEK FULL MARKS-50

List and subject contents are given under the heading ELECTIVE SUBJECTS

(ET 851) OPTO-ELECTRONICS AND OPTICAL COMMUNICATION LAB

3 HOURS PER WEEK(FULL MARKS:100)

Experiments of this laboratory are based on OPTO-ELECTRONICS AND OPTICACOMMUNICATION (ET 801).

(ET 852) SWITCHING AND COMPUTER NETWORKING LAB

3HOURS PER WEEK(FULL MARKS: 50)

Experiments of this laboratory are based on i) TELECOMMUNICATION SWITCHING (ET 803) ii) COMPUTER NETWORK AND COMMUNICATION(ET 802)

(ET 853/d) ELECTIVE II LAB

3 HOURS PER WEEK(FULL MARKS: 50)

Experiments of this laboratory are based on ELECTIVE II (ET 804/X) subject chosen.

(ET 854) PROJECT AND THESIS

6 Hours/Week Full marks-150

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This sessional work entails carrying out a project investigation and presentation of a thesis based on project work done. The project work will involve a review work which is already completed by the project group in PROJECT PRELIMINARIES(ET 710), planning/design/construction and testing/software development/experimentation on the problems already assigned to the students in the 7th Semester. The thesis part of the sessional will be a presentation of the results achieved and observations made during the project work in an organized manner. Every student will be required to submit the thesis before the evaluation of his/her performance in the sessional work.

(ET 871) VIVA-VOCE IV

(Full Marks:100)

A viva voce test for the students will be taken at the end of 8th Semester to evaluate their depth of knowledge and level of understanding of different subjects studied by them in this field of engineering.

ELECTIVE SUBJECTS

ELECTIVE I (7th Sem ETC)

1) Digital Image Processing and Pattern Recognition (ET 706/1)

2) Non-Conventional Energy Systems (ET 706/2)

3) VLSI Logic Design (ET 706/3)

ELECTIVE II (8th Sem. ETC)

1) Bio-medical Electronics (ET 804/1)

2) Advanced Control Systems (ET 804/2)

3) VLSI Physical Design (ET 804/3)

4) EMI/EMC (ET 804/4)

ELECTIVE III (8th Sem Non Dep.)

1) Satellite Communications (ET 805/1) [For CST/EE]

2) Environmental Instrumentation (ET 805/2) [For CE/Mech.E/Met.E/EE]

(ET 706/1) DIGITAL IMAGE PROCESSING AND PATTERN RECOGNITION

(3L+1T)/WEEK FULL MARKS-100

Background: Introduction to electronic systems for image transmission and storage, computer processing and recognition of pictorial data, overview of practical applications.
Fundamentals: mathematical and perceptual preliminaries, human visual system model, Imaging geometry and perspective transformations, unitary transforms, DFT, DCT, Hadamard, K-L Transforms.

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Image Processing Techniques: Image enhancement, image restoration, image feature extraction, image data compression, pattern recognition methodologies, statistical, syntactic and fuzzy theory approaches, Feature extraction and selection, Parametric and non-parametric classification, clustering. Learning and Neuro Computing, Genetic algorithms for pattern recognition, application of pattern recognition.

Text Books/References:

1) Digital image processing- Gonzalez & Woods
2) Picture processing-Rosenfield & Kak
3) Digital image processing-Pratt
4) Pattern recognition principles-Tou & Gonzalez

(ET 706/2) NON-CONVENTIONAL ENERGY SYSTEMS

(3L+1T)/WEEK FULL MARKS-100

Different non-conventional energies: Solar, wind, tidal OTEC, Bio-mass, mini & micro-hydel: Principles of operation of various pyranometers, pyrheliometers by PC based on-line measurement, solar constant.
Principle of Photovoltaic Conversion: Various configuration of solar cells, methods of improving their efficiency, PV modules, panels, arrays & systems, PV system configuration and BOS components, choice of battery, Array and battery sizing.
Principle of Solar Thermal Conversion, solar thermal collectors, solar air heaters, solar water heating systems, solar cookers, solar ponds, solar thermal power cycles, parabolic concentrators, Integrated approaches.
Wind Energy: basic principles of wind energy conversion, wind data, energy estimation and site selection, types of wind machines. Wind generators: selection, installation and maintenance, simulated studies.
Bio mass energy: conversion technologies, classification of bio-gas plants, utilization of bio-gas, bio-mass gasifiers, bio methanation, performance prediction & case studies.
Geothermal Energy: types, vapour-dominated system, liquid dominated system, petrothermal system, operational and environmental problems.
Tidal Energy: wave motion, wave energy conversion, tides, tidal systems. Mini and micro hydel power plants, site selection and potential, comparison with other sources.
Hybrid Energy Systems: combination of various non-conventional sources, site-specific applications, centralized & decentralized approaches, integrated rural energy planning.
Economics: various system and component costs, pay-back period, life cycle cost, employment generation schemes and entrepreneurship development programmes.

Text Books/References:

1) Non-Conventional energy sources- Rai
2) Solar Energy: Principles & Storage-S.P. Sukhatme

(ET 706/3) VLSI LOGIC DESIGN

(3L+1T)/WEEK FULL MARKS-100

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Finite State Machine, Sequential machine, Synchronous and asynchronous machine; Design and minimization procedure of synchronous and asynchronous machine. Moore and Mealy machine; concept of latches and flip-flops; Basic idea of memory design; layout design methods, combinational network delay, static and dynamic time analysis, clocking strategies, sub-system design, ASIC design: Case study; Testing methods of VLSI logic circuits.

Text Books/References:

1) Contemporary Logic Design- Randy H. Katz
2) Finite state automata-J.Mann
3) Switching theory and finite automata- Kohavi

(ET 804/1) BIO MEDICAL ELECTRONICS

(3L+1T)/WEEK FULL MARKS:100

Characteristic of living bodies: biological parameters: detection, measurement and control. Interfacing of biomedical electrical and electronic equipment with living system. Bioelectric potential: genesis and measurement, ECG, EMG and EEG instruments, there working principles, testing procedures and analysis of recorded bio-signal characteristics, associated electronic circuits. Bio medical transducers. Electro medical diagnostic techniques like X-Ray, ultrasonography, computer aided tomographic imaging, MR imaging, Therapeutic and prosthetic equipment like pacemaker, hearing aid, myo electric arm, cardiac defibrillator, haemo-dyalisis machine. Biotelemetry: lithotripsy, laser surgical probe. Computers in biomedical studies: computer assisted disease identification, arrival of therapeutic strategy, hospital care system. Simulation of biological systems.

Text Books/References:

1) Introduction to biomedical equipment technology-Carr
2) Biomedical instrumentation & measurement- Cromwell
3) Principles of medical electronics & biomedical instrumentation-C. Raja Rao,S.K. Guha

(ET 804/2) ADVANCED CONTROL SYSTEMS

(3L+1T)/WEEK FULL MARKS-100

Review of control theory. Non-linear control systems describing function and its application to different types of non-linearity. Linearisation of nonlinear system. Dither signal concepts Principles of process control, control schemes, Typical processes and there mathematical modeling, control of process parameters – pressure, temperature, liquid level, hydraulic, pneumatic and electronic

controllers. Digital computer as process controller. Introduction to numerical control, selection and collection of numerical control, numerical control system components (transducers and numeric actuating devices). Adaptive control system – signal synthesis of adaptive system and its dynamic optimization using calculus of variation. Control system components – error-sensing devices, synchros, servomotors, DC and AC tacho generators. Digital control systems-Z-transform concept, state space analysis of sample data systems. Frequency response and nyquist criterion S-D systems.

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Text Books/References:

4) Automatic Control System-Kuo
5) Modern Control Engineering- Ogata
6) Control System Engineering- Gopal, Nagrath

(ET 804/3) VLSI PHYSICAL DESIGN

(3L+1T)/WEEK FULL MARKS-100

Fundamental of algorithm, Basic idea of graph theory, VLSI Model, Algorithm design for VLSI, Various types of partitioning algorithm; Kernighan-Lin algorithm, Simulated Annealing algorithm etc. Different types of floor planning and placement algorithm. Pin assignment, Global routing, detailed routing, specialized routing, compaction. Layout algorithms; Maze running algorithms, Lee Algorithm, Hadlocks Algorithm etc. Algorithms for VLSI design Tools.

Text Books/References:

1) VLSI physical design automation-Sadique M Sait & Habib Youssef
2) Computational aspects of VLSI- Jeffry D. Ullman
3) An introduction to VLSI physical design- M. Sarrafzadeh, C.K.Wong
4) VLSI physical Design- Navin Sharwani

(ET 804/4)ELECTRO-MAGNETIC-INTERFERENCE/ELECTRO-MAGNETIC-COMPATIBILITY (EMI/EMC)

(3L+1T)/WEEK FULL MARKS-100

Common mechanism of electrical noise coupling, other noise sources, importance of EMI/EMC in day to day life and its application in multidisciplinary problems, general methods of elementary interference. EMC rules and regulations, importance of considering EMC at the design level of different components and systems, choice of passive components, EMC requirements for electronics systems, radiated emission, conducted emission, radiated susceptibility, conducted susceptibility, electrostatic discharge, design constraints, advantage of EMC design, antennas for EMC, signal spectra, non-ideal bahaviour of components, printed circuit board design including details on LISN, power line EMI, application in LSI/VLSI, EMI reduction via shielding of conductors, via ground techniques and other techniques, shielding effectiveness of a metallic sheets.

Text Books/References:

1.Introduction to electromagnetic compatibility-Clayton.R.Paul (John Wiley)
2. EMI/EMC-G.K. Deb

(ET 805/1) SATELLITE COMMUNICATION(For CST/EE)

(2L)/WEEK FULL MARKS-50

Principle of satellite communication, Freq. allocation, band spectrum, active & passive satellite, Look Angle determination.
Launching of satellite, satellite orbit & inclination, AOCS, Telemetry, Tracking and command, Power systems, spacecraft antennas.

Communication satellite link designs- Uplink, downlink, Basic Transmission theory.
Satellite analogy communication-Analog FM/FDM, TV satellite link, and SCPC, CSSB, S/N and C/N ratio in freq. modulation.
Digital satellite transmission-Elementary idea of digital communication, digital modulation technique, satellite digital link design, TDM.
Multiple access techniques-TDMA, CDMA and hybrid access techniques, DA-FDMA, DA-TDMA, digital speech interpolation, spread spectrum techniques, random access technique and packet satellite communication.
Satellite Earth stations.
Special Purpose Communication satellite-VSAT , INMARSAT, MSAT, LANDSAT, INTELSAT.

Text Books/References:

1) Satellite Communication- T. Pratt & W. Boston
2) Satellite Communication- Roddy

(ET 805/2) ENVIRONMENTAL INSTRUMENTATION(for CE/Mech.E/Met.E/EE)

(2L)/WEEK FULL MARKS-50

History of environmental pollution and its control: Early history, Air pollution episodes, water pollution regulation of U.S., Air pollution regulation of U.S , Los Angeles Smog.
Measurement Fundamentals: Units and nomenclature of basic environmental variables, density and concentration, Reaction Stoichiometry, Temperature, Pressure. Statistical methods in experimental measurements: statistical distributions, regression analysis, error propagation. Standards and calibration. Reliability constants: mean time between failure, causes of failure. Mathematical modeling of instruments. Noise measurements, noise reduction techniques. Review of physical fundamentals.
Temperature Measurements: air temperature, soil temperature. Soil heat flux measurement, calibration of heat flux transducers. Radiation measurement, calibration and photometry. Humidity and moisture measurement, calibration of humidity sensors. Wind speed and direction measurements.
Pressure measurements: mercury barometer, aneroid barometer.
Data Acquisition Concepts: digital data acquisition, system sampling considerations. Signals and noise, IEEE 488 interface.

Text Books/References:
1) Environmental Instrumentation- Fritschen & Gay

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DEPARTMENT OF HUMANITIES

DEPARTMENT OF HUMANITIES

APPROVED SYLLABUS for UNDERGRADUATE (B.E.) COURSE

1st & 2nd semester B.E.. Courses

HU 1201 PROFESSIONAL COMMUNICATION IN ENGLISH (for all Engg. Branches)

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SEMESTER EXAMINATION: **CONTRACT PERIODS: (2 L + 1T)**
TIME – 2Hrs. **Continious Assessment :**
Full Marks -35 **Full Marks -15**

Group A
Note making
Paragraph writing
Commercial Correspondence
Precis
Preparing Instruction Manuals
Preparing Proposals
Report Writing
Writing of Dissertation / Thesis
Elements of Grammar and Vocabulary

Group B
Group Discussion
Extempore Speaking
Presentation Strategies
Interview Preparation

This course seeks to develop a sence of language through texts drawn from contemporary writings in newspapers, newsmagazines, reports etc.

List of Text and Reference Books

Oxford Book of writing & Speaking	Peter Seeley
Technical Communication Principles and Practice	Meenakshi Raman & Sangeeta Sharma

Other course materials to be developed by concerned teachers

HU 101A ENGLISH FOR ENGINEERS (for Architecture)

SEMESTER EXAMINATION: **CONTRACT PERIODS: (2 L +1T)**
TIME – 2Hrs. **Continious Assessment :**
Full Marks -35 **Full Marks -15**

Group A
Note making
Paragraph writing

Commercial Correspondence
Precis
Preparing Instruction Manuals
Preparing Proposals
Report Writing
Writing of Dissertation / Thesis
Elements of Grammar and Vocabulary

Group B
Group Discussion
Extempore Speaking
Presentation Strategies
Interview Preparation

This course seeks to develop a sence of language through texts drawn from contemporary writings in newspapers, newsmagazines, reports etc.

List of Text and Reference Books

Oxford Book of writing & Speaking	Peter Seeley
Technical Communication Principles and Practice	Meenakshi Raman & Sangeeta Sharma

Other course materials to be developed by concerned teachers

Economics and Accounts : Hu-5601

(5th & 6th Semester)

Economics (1st Half)

A. General : Introduction ; markets – The market Forces of Supply and Demand; Elasticity of Demand.
B. Microeconomic Theory : Consumer Behaviour ; Production : Cost Curves ; Types of Industry and Profit Maximization.
C. Macroeconomic Theory : Macroeconomic Data; Measuring national Income ; Simple Income Determination ; Government Policy ; Major Macroeconomics Problems.

Reference :

Lipsey & Chrystal, Principles of Economics

Accounts (2nd half)

1. Financial Accounting : Definition basic accounting process ; preparation of Final Account ; Trading, Profit & Loss Account Balance Sheet.
2. Cost and Management Accounting : Definition, Cost terms – Cost Classifications;
3. Accounting for Overhead Cost : Concept – Allocation, Apportionment and Absorption.
4. Methods of Costing – Unit / Ouput Costing ;
5. Techniques of Costing : Overview Marginal Costing and CVP Analysis ; Overview of Budgets.

Text Books :

a) Accountancy, by Hanief and Mukherjee (TMH Publication)

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b) Cost Accounting by Jain and Narang (Kalyani Publishers)
c) Cost Accounting by Prof. B. Banerjee (World Press)

<u>Reference Books :</u>

a) Cost Accounting : a managerial emphasis by C.T. Horngren, G. Foster and S.M. Datar (PHI)
b) Cost & Management Accounting by Collin Drury

Principles of Management : Hu-5602

[5^{th} & 6^{th} Semester- All branches] : 50 marks

A. Introduction to Management :
What is management ? Scope and process of management; functional areas of management ; business environment ; value chain analysis; SWOT; objectives, strategies and plans.
[8 hrs.]

B. Marketing Management :
The marketing concept ; marketing environment; marketing objectives and strategies; marketing mix variables, PLC,

marketing planning and control. [8 hrs.]

C. Organisational Behaviour :
Scope, Learning, Attitude, Perception, Cooperation & Conflict, Motivation, Leadership, Gender Issues, Work Culture.
[8 hrs.]

D. Financial Management :
Definition and scope of finance function; objectives of FM; fundamental of working capital management; capital budgeting / project evaluation techniques. [8 hrs.]

Reference Books:

For A. 1. Management Today by Burton & Thakur
2. Management by Stoner, Freeman & Gilbert.

For B. 1. Marketing Management by Philip Kotler.
2. Marketing Management by Ramswamy & Namakumari

For C. 1. Organisational Behaviour by Fred Luthans
2. Organisational behaviour by Stephen P. Robins.

For D. 1. Finance Management by Khan & Jain
2. Finance Management by Prasanna Chandra.

Values & Ethics for ARTP , : Hu-501A

(5^{th} Sem.) Full Marks: 50

1.1 Introduction – Definitions, objectives and issues in value and ethics.

1.2 Values and ethics – from lore to science. (2 contact hours)

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2.1 Considering ethical dilemma. Concept of relative values – social, professional, and ethical. Importance of values and ethics in corporate world.

2.2 Formulation of appropriate strategies incorporating value and ethics.

3.1 Democratic values. Issues in governance and responsibility.

3.2 Promotion of values in public services.

3.3 Case studies and seminar lectures. (6 contact hours)

Basic Reading.

- Alger, et al, Ethical Problems in Engineering, Wiley, New York, 1965.
- Baum, R.J., ed, Ethical Problems in Engineering, Second Edition, Volume Two: Cases, Center for the Study of the Human Dimensions of Science and Technology, Rensellaer Polytechnic Institute, Troy, New York, 1980.
- Bennett, F. L., The Management of Engineering: Human, Quality, 2nd Ed., Prentice-Hall, Englewood Cliffs, NJ 1989.
- Chackraborty, S.K., The Management and Ethics Omnibus, Oxford University Press, New Delhi, 2001.
- Thomas, J.M. Ethics and Techno culture, University Press of America, Lanham, MD, 1987.
- Unger, S.H., Controlling Technology: Ethics and the Responsible Engineer, Holt, Rinehart and Winston, New York, 1982.
- Westphal, D., Westphal, F., Planet in Peril: Essays in Environmental Ethics, Harcourt Bracer College Publishers, Orlando, FL 32887, 1994.

PROFESSIONALVALUE & ETHICS : (Hu-7801) (7th Sem.)

The Course. (Full Marks 50)

3.4 Introduction – Definitions, objectives and issues in value and ethics.

3.5 Considering ethical dilemma. Concept of relative values – social, professional, and ethical. Importance of values and ethics in corporate world.

3.6 Formulation of appropriate strategies incorporating value and ethics.

3.7 Democratic values. Issues in governance and responsibility.

3.8 Promotion of values in public services.

3.9 Indian value system. Its application in corporate life.

3.10 Values and ethics – from lore to science.

3.11 Role of value and ethics in the wider social perspective.

3.12 National and international case studies in value and ethics

3.13 Seminar lectures by eminent practitioners from various fields

Basic Reading.

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- Alger, et al, Ethical Problems in Engineering, Wiley, New York, 1965.
- Baum, R.J., ed, Ethical Problems in Engineering, Second Edition, Volume Two: Cases, Center for the Study of the Human Dimensions of Science and Technology, Rensellaer Polytechnic Institute, Troy, New York, 1980.
- Bennett, F. L., The Management of Engineering: Human, Quality, 2nd Ed., Prentice-Hall, Englewood Cliffs, NJ 1989.
- Chackraborty, S.K., The Management and Ethics Omnibus, Oxford University Press, New Delhi, 2001
- Callahan, J.C., ed, Ethical Issues in Professional Life, Oxford University Press, New York, 1988.
- Chalk, R., Franke, M. and Chafer, S.B., AAAS Professional Ethics Project: Professional Ethics Activities of the Scientific and Engineering Societies, American Association for the Advancement of Science, Washington, D.C., December, 1980.
- Chevron Corporation, Our Business Conduct: Principles and Practices, 1986.
- Jackall, R., Moral Mazes: The World of Corporate Managers, Oxford University Press, New York, 1988.
- Petroski, H., To Engineer is Human: the Role of Failure in Successful Design, St. Martins Press, New York, 1982.
- Popper, The Open Society and Its Enemies, Vol. 1 Routledge and Kegan Paul, London, 1980.
- Rachels, J., The Elements of Moral Philosophy, Random House, New York, 1986.
- Thomas, J. M., Ethics and Techno culture, University Press of America, Lanham, MD, 1987.
- Unger, S.H., Controlling Technology: Ethics and the Responsible Engineer, Holt, Rinehart and Winston, New York, 1982.
- Westphal, D., Westphal, F., Planet in Peril: Essays in Environmental Ethics, Harcourt Bracer College Publishers, Orlando, FL 32887, 1994.

Business English : Hu-801

(Elec-III, 8th Semester)

1. Grammar & Vocabulary :
   - Revision;
   - Usage Exercises;
2. Composition :
   - Paragraph Writing;
   - Memo Writing;
   - Note making;
   - Precise writing.
3. Business Correspondence:
   - A wide range of topics including enquiries, complaints payments, banking, insurance, appointment seeking and job applications.
4. Technical Report Writing;
   - Document style, logical structure, content list, chapter order, appendix material.
5. Formulation of Proposals
6. Dissertation Writing.
7. Reading & Listening Comprehension.
8. Handling Group Discussions & Interviews.

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9. Oral Presentations.

Environmental Management : Hu-802

A. Introduction

1. Why environment not like other products
2. Why are persons like you studying environmental management? (includes history if environmental concern)
3. What do environmental managers need to do?

B. Main types of environmental degradation
C. Environmental laws and their implementation
D. Environmental Impact Assessment, Cost Benefit Analysis, Valuation.
E. Industrial Response to Environmental Issues
F. Environmental Ethics (including Social Issues)
G. Trade and Environment
H. Specific Case Studies.

a. Transport Pollution (pollution of air)
b. Urban Waste Management (pollution of land, water)
c. Forest Management (renewable resources)
d. Mining and Environment (non-renewable resource)
e. Fly ash pollution (industrial pollution of air, land, water)

Other case studies may also be done.

MARKETING MANAGEMENT: Hu-803

[Elective-III (ND) – 8th Semester]

Unit description	Hours
1. Introduction to marketing career opportunities in marketing; evolution of marketing concept / philosophies; practice of marketing by Indian companies; meaning of need, want, and demand; marketing management tasks.	4
2. Marketing environment – components of the environment; analysis and identification of marketing opportunities and deciding on the scope of operation; major classes of growth opportunities ; product-market expansion matrix.	4
3. Analysing buying behaviour of consumer markets and organisational markets; understanding market segments and target marketing.	4
4. Components of a marketing plan; product life cycle strategy; new product development strategy.	4
5. Marketing mix; elaboration of marketing mix elements; product, price, place and promotion decisions.	10
6. Marketing research: use of market information to guide marketing actions, designing and conducting a marketing research programme.	6

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7. Export marketing; deciding when to export; selecting target export markets; designing export marketing programme. 4

8. Services marketing; marketing of various types of services; issues in services marketing mix ; service marketing strategies. 4

9. Case studies, class tests, seminar. 10

50

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Reference Books :

1. Marketing Management by Philip Kotler.
2. Marketing Management by Ramswamy & Namakumari

Business Finance : Hu-804

(Elective-III, For B.E. 8th Semester]

I. **Fundamental Analysis**

a) Funds Flow Statement
b) Cash Flow Statement
c) Ratio Analysis

II**. Financial Planning and Control**

-- Budgets – Master and Functional – Fixed and Flexible - ZBB

III. Financial Decision Making Cost of Capital

a) Capital, Budgeting – Concept and Techniques
b) Performance Evaluation
-- Division – Project – Prediction of sickness

IV. Working Capital Management

a) Concept – forecasting
b) Cash Management
c) Receiving Management
d) Inventory Management

V. Concepts of the Following

a) Risk Management and Hedging
b) Capital Structure
c) Term Lending and Financing
d) Indian Financial Systems.

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Text Books :

1. Financial Management by I.M. Pandey
2. Financial Management by P. Chanda
3. Financial Management & Policy by B. Banerjee

Reference : 1. Financial Management Policy – James C. Van Worne (PHI)

HUMAN DEVELOPMENT : (Hu-805)

(8th Semester)

The Course.

1.1 Introduction. Definition of Human Development (HD) – its scope and nature. The need to study HD – HD for engineers
1.2 Historical background of HD. Theories and practice of HD. Brief outline of HDI.
1.3 Role of social institutions in HD. Social movements and HD. Students and their importance in development process.
1.4 The economics of development or development economics
1.5 The preservation of the environment for HD
1.6 Issues in human development – childhood, gender, disability, displacement, deviance, human rights, intellectual property rights, labor, population
1.7 Science, technology and HD. Globalization and HD. Politics of HD.
1.8 Whither development
1.9 Projects on development issues
1.10 Seminar lecture series on human development

Basic Readings.

Ahmad, E., J. Dreze, J. Hills and A. Sen (eds.), 1991, *Social Security in Developing Countries,* Clarendon Press for WIDER, Oxford

Ahn, T.K., Ostrom, E. (eds.), 2003, *Foundations of Social Capital*, Edward Elgar Publishing Ltd, Cheltenham, U.K.

Aksah, M. M, 2000, 'Rights Based Approach to Development and Right to Land', *Background Paper for HDR 2000*, UNDP, New York

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World Bank, 1997, *The State in a Changing World: World Development Report 1997,* Oxford University Press, Oxford

DEPARTMENT OF INFORMATION TECHNOLOGY

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APPROVED SYLLABUS for UNDERGRADUATE (B.E.) COURSE

3rd SEMESTER - INFORMATION TECHNOLOGY

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IT301 : **NUMERICAL ANALYSIS AND FUNCTIONAL OPTIMIZATION**

FM – 100 Contact Periods : 3L+1T per week

Errors in Numerical Computation. Transcendental and Polynomial Equations. System of Linear Algebric Equations and Inverse of a Matrix. Eigen value problem. Interpolation and Approximation. Numerical Differentiation. Numerical Integration. Numerical Solution of Ordinary Differential Equations. Unconstrained and Constrained minimization of Functions. Linear Programming. Duality Dynamic programming. Principal of optimality.

I***T302:*** **ALGORITHM & DATA STRUCTURE**

FM-100 Contact Periods:3L+1T per week

INTRODUCTION : Data Types, Abstract Data Types, Structures and their implementations, Analysis of Algorithms, Order of magnitude, Stacks and Queues : ADT Stack, Array Implementation Multiple Stacks, Applications of Stacks: Conversion from Infix to Postfix, Evaluation of Postfix Expressions, Prefix Notation, etc.

ADT queue, Linear Queue, Circular Queue, De-queue, Priority Queue, Array Implementations of Queues, Applications of Queues, Generals Lists.

RECURSION: Introduction, Factorials, Power Function, GCD, Palindrome, Decimal to Binary Conversion, Fibonacci numbers, Counting Clusters in a Table, Towers of Hanoi, Generating Permutations, Indirect Recursion etc., Tail Recursion, Removal of Recursion.

LINKED LISTS: ADT pointer and Implementation, ADT Linked Lists, Circular Linked Lists, Doubly Linked Lists, Implementation of Linked Lists, Linked Stacks and Queues, Application of Linked List: Polynomials, High precision Arithmetic, Josephus Problem.

SEARCH METHODS AND TABLE DATA TYPE : Sequential Search, Sequential Search in Ordered Lists, Binary Search, Analysis of Searching Methods, Table Data Type, Multi dimensional Arrays, Triangular Tables, Jagged Tables, Inverted Tables, Hash Table and Hashing, Hash Function, Open Addressing, Separate Chaining and Coalesced Chaining, Bucket Hashing, Analysis of Hashing, Implementation of Table Data Type.

BINARY TREES: Tree Terminology, ADT Binary Tree, Binary Tree Implementations, Binary Tree Traversals, Threaded Binary Tree, Binary Search Tree, AVL Tree, Suitable Applications of Binary Trees.

SORTING: Introduction, Selection Sort, Bubble Sort, Insertion Sort, Shell Sort, Quick Sort, Merge Sort, Address Calculation Sort, Tree Sort, Heap Sort, Performance and Comparison of sorting Techniques, etc.

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IT 303: **DISCRETE MATHEMATICS**

FM-50 Contact Priods: 2L per week

Set Theory & Algebra: Sets; Relations; Functions; Groups; Partial Orders; Lattice; Boolean Algebra.

Mathematical Logic: Propositions and Operators, Truth Table, Equivalence etc. Predicate Calculus: Introductory Idea.

Mathematical Induction: Applications in different problem domains.

Combinatorics: Permutations; Combinations; Counting; Summation; Sequence and Discrete functions; Generating functions; Recurrence relations; Asymptotics.

IT 304: Graph Theory &Application

FM-50 Contact Priods: 2L per week

Introduction to Graph, Graphs and their basic properties- Degree. Path, Cycles, Subgraph, Isomorphism, Data Structure for Representation, Traversal, Spanning Tree, DFS & BFS tree, Rooted Tree and Binary Tree, Tree Traversal, Searching etc., Planarity, Independent Sets, Vertex covers, Matching and Colouring, Eulerien and Hamiltonian walk and their Applications in Computer Science.

IT-305 **: DIGITAL CIRCUITS AND LOGIC DESIGN**

FM – 100 Contact Periods: 3L+1T per week

- Number representation and Computer arithmetic (fixed and floating point)
- Logic Gate Circuits (SSI, MSI, LSI, VLSI etc.)
- Logic functions; Implementation; Minimization
- Combinational Logic Design using MSI Circuits (Multiplexer, Demultiplexer, Encoder, Decoder, ROM)
- Sequential Circuits; Flip Flops (Clocked SR, JK, D, T) and their applications; Registers; Counters; A/D and D/A Converter.
- Digital Logic Families: RTL, I^2L, ECL, TTL (Schottky, 5400/7400 series), MOS and CMOS Logic with comparison.
- Semiconductor Memories: Different types of RAM and ROM.
- Programmable Logic Devices: PLD, PLA, PAL, FPGA.

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IT 306 : **NUMERICAL ANALYSIS & FUNCTIONAL OPTIMIZATION LAB**

FM – 50 Contact Periods : 3P. per week

Laboratory exercises are based on the theory subject. Numerical Analysis and Functional Optimization ***IT 301***

IT 307 : **Advanced C PROGRAMMING**

FM – 50 Contact Periods : 3P. per week

Implementation of advanced features of C programming like Pointers, file handling etc.

IT 308: **DATA STRUCTURE LABORATORY**

FM-100 Contact Periods: 6P. per week

Laboratory work using C language for implementation of Data Structure and the Algorithms based on the course No. IT 302 (Algorithm and Data Structures) and experimental verification of complexities of the tested algorithms.

IT 309 **: DIGITAL CIRCUITS AND LOGIC DESIGN LABORATORY**

FM – 100 Contact periods: 3 P. per week

Experiments are based on the theory subject Digital Circuits and Logic Design (IT 304).

4th SEMESTER - INFORMATION TECHNOLOGY

IT-401: COMPUTER ORGANIZATION & ARCHITECHTURE

FM – 100 Contact Periods : 3L+1T per week

Basic organization of the computer and block level description of the functional units as related to the execution of a program; Fetch, decode and execute cycle; role of operating systems and compilers (introduction only); Assembly language programming :instruction set, instruction cycles, registers and storage, addressing modes; discussions about RISC versus CISC architectures; Inside a CPU: information representation, computer arithmetic and their implementation; control and data path, data path components, design of ALU and data path, controller design; Memory and IO access: Memory maps, Read Write operations, Programmed IO, Concept of handshaking, Polled and Interrupt driven IO, DMA data transfer; IO subsystems: Input-Output devices such as Disk, CD-ROM, Printer etc.; Interfacing with IO devices, keyboard and display interfaces; Inside the Memory: memory organization, static and dynamic memory; Cache memory and Memory Hierarchy – cache memory access techniques; Virtual memory; Introduction to Multiprogramming and Multiprocessing;

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Introduction to pipelined operation and architecture.

IT 402: **OPERATING SYSTEMS**

FM – 100 Contact Periods : 3L+1T per week

Operating System Overview, Evolution of Operating Systems, PC Hardware and x86 Programming, Address Spaces, Address Spaces on the x86,
Structural overview, Interrupts -- hardware and software, privileged instructions, role of interrupts in operating system functions;
Multiprocessing and Multiprogramming;

Concept of process and Process synchronization, Process Management and Scheduling,
Hardware requirements: protection, context switching, privileged mode; Threads and their Management,
Interprocess Communication, Kernel API, Detection and Prevention of deadlocks, Dynamic Resource Allocation

Memory Management: paging, virtual memory management, Design of IO systems, File Management, Device drivers, concept of driver routines.

Case Studies: DOS/WINDOWS, UNIX/LINUX

IT 403: **SIGNAL & SYSTEMS**

FM – 100 Contact Periods : 3L+1T per week

Classification and representation of Signals. Concepts of Linear Vector Space and Orthogonal Signal representation. Signal and System Bandwidth consideration. Linear Time Invariant (LTI) Systems. Discrete Time Signals, Systems and their classification. Fourier Analysis for Continuous Time Systems and Discrete Time Systems. Sampling, Digitisation and Reconstruction of Analog Signals. Laplace Transforms. Random variable & processes. Random Signals and their properties. Auto and Cross-correlation Functions. Power Spectral Density. Ergodic process. System response to Random Signals.

IT 404: **FORMAL LANGUAGE & AUTOMATA THEORY**

FM – 100 Contact Periods : 3L+1T per week

Alphabet, languages and grammars. Production rules and derivation of languages. Chomsky hierarchy of languages. Regular grammars, regular expressions and finite automata (deterministic and nondeterministic). Closure and decision properties of regular sets. Pumping lemma of regular sets. Minimization of finite automata. Left and right linear grammars. Context free grammars and pushdown automata. Chomsky and Griebach normal forms. Parse trees. Ambiguity and properties of context free languages. Pumping lemma, Ogden's lemma, Parikh's theorem. Deterministic pushdown automata, closure properties of deterministic context free languages.

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Turing machines and variation of Turing machine model, Turing computability, Type 0 languages. Church Turing hypothesis. Recursive and recursively enumerable sets.. Universal Turing machine and undecidable problems.

Text Books:

J. E. Hopcroft and J. D Ullman: Introduction to Automata Theory, Languages and Computation, Addison Wesley Publ., New York..

H. R. Lewis and C. H. Papadimitriou: Elements of the Theory of Computation,

Prentice Hall, Englewood Cliffs.

IT 405: COMPUTER GRAPHICS

FM-100 Contact Periods: 3L+0T per week

Interactive graphics programming, Graphical input & output devices, Basic raster graphics : Scan conversion, Clipping, Filling, Geometric manipulation : Transformation, Homogeneous Coordinate systems, Plane projection, Vanishing points.

IT 406: OPERATIONS RESEARCH

FM-50 Contact Periods: 2L+0T per week

Introduction: Decision making, Development of OR, Application of OR.

Linear Programming: Formulation of LP Models, Graphical solution, Simplex Method, Duality theory and application. Transportation Problem. Assignment Problem.

Network models: Introduction, CPM and PERT, Crashing Networks.

Waiting Line Models: Elements of queuing models. Poisson arrival and exponential service time distributions, M/M/1 Queue. Finite population models. Queuing cost models. Applications.

Simulation: Simulation modeling, Use of random numbers, Flow chart development, Examples.

Inventory Control: Introduction, Costs, Deterministic and Stochastic models: Buffer stocks.

IT 407: COMPUTER ORGANIZATION & ARCHITECTURE LAB

FM – 50 Contact periods: 3 P. per week

Experiments are based on the theory subject Computer Organization & Architecture (IT 401).

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IT 408: **OPERATING SYSTEM LAB**

FM – 100 Contact periods: 3 P. per week

Experiments are based on the theory subject Operating Systems (IT 402).

IT 409: **OPERATION RESEARCH LAB**

FM – 50 Contact periods: 3 P. per week

Experiments are based on the theory subject Operation Research (IT 406).

IT 410: **COMPUTER GRAPHICS LAB**

FM – 50 Contact periods: 3 P. per week

Experiments are based on the theory subject Computer graphics (IT 405).

5th SEMESTER - INFORMATION TECHNOLOGY

IT-501: **COMMUNICATION SYSTEM**

FM – 100 Contact Periods : 3L+1T per week

Analog Communications: Elements of Analog communications

Digital Communications: Elements of Information Theory. Source coding theorem, Huffman coding, channel coding theorem, channel capacity theorem. Waveform coding,- PCM and Delta modulation, base band shaping for data transmission. Nyquist criterion for ISI and eye pattern. Equalization. Digital modulation techniques coherent and non coherent detection. .Bit Vs symbol error probability and bandwidth efficiency. Error control coding, rationale for coding. Linear block codes, cyclic codes and convolutional codes.

IT 502: MICROPROCESSORS

FM – 100 Contact Periods : 3L+1T per week

Introduction to CISC – RISC microprocessors. Hardware and Architecture of 8/16/32 bit Microprocessors -- Case Studies.

Instruction types, addressing mode, interrupt structure

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Assembly Language Programming on 16/32 bit machine. Hardware and software interrupt management. Memories & Interfacing. Basic I/O Interfacing – Parallel I/O, Serial I/O. DMA controller, interrupt controller. Micro controller. Selected Applications of Microprocessors.

IT 503: DATABASE MANAGEMENT SYSTEM

FM-100 Contact Periods: 3L+1T per week

Basic concepts, Advantages of Database systems over traditional file processing system.
Database System Architecture: Data Abstraction, Data Independence, Data Definition and Data Manipulation Languages.

Data Models: Entity-Relationship, Network, Relational and Object Oriented Data Models, Integrity Constraints, and Data Manipulation Operations.

Relational Query Languages: Relational Algebra, Tuple and Domain Relational Calculus, SQL and QBE.

Relational Database Design: Domain and Data dependency, Armstrong's Axioms, Normal Forms, Dependency Preservation, Lossless design.

Query Processing and Optimization: Evaluation of Relational Algebra Expressions, Query Equivalence, Join strategies,Query Optimization Algorithms.

Storage Strategies: Indices, B-trees, Hashing.
Transaction Processing: Recovery and Concurrency Control, Locking and Timestamp based Schedulers, Multiversion and Optimistic
Concurrency Control schemes.

Advanced Topics; Object-oriented and Object Relational Databases, Logical Databases, Web Databases, Distributed Databases, Data Warehouse and Data Mining.

IT-504: SYSTEMS PROGRAMMING

FM – 100 Contact Periods : 3L+0T per week

Introduction: System Software and Application Software,
Assembler: Assembler Functions, Machine Dependent and Independent Assembler Features, Assembler Design Options
Macro Processor: Macro Processor Functions, Machine-Independent Features and Design Options
Loader: Loader Functions, Machine-Dependent and Independent Features and Design Options
Linker: Linker Functions, Machine-dependent and Independent Features and Design Options
Compiler: Compiler Functions, Machine Dependent Compiler Features, Machine-Independent Compiler Features, Compiler Design Options
Operating System: Basic Operating System Functions, Machine-Dependent and Independent Operating System Features, Operating System Design Options
Other System Software: Text Editors, Debuggers

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***IT 505:* OBJECT ORIENTED METHODOLOGY & PROGRAMMING**

FM-100 Contact Periods: 3L+0T per week

UML

UML Overview- UML Background, Goal of UML, UML concept areas, Syntax of expressions and diagrams,& Models and its levels.
UML Concepts -UML views
Static view, use case view, Interaction view, state machine view, Activity view,
Physical view, Modal management view, Extensibility construction,
Connections Among views.
Static View-Classifiers, relationships, Associations, Generalization, Realization, Dependencies, Constraint, Instances.
Use Case View – Overview, Actor, Use case.
State Machine View –Overview, state machine, Event, State, Transition, Composite States.
Activity View-Overview, Collaboration, Interaction, Sequence Diagram, Activation, Collaboration Diagram, Patterns.

Physical View-Overview, component, Node.

Modal Management View-Overview, Package, Dependencies on Packages, Access and Import Dependency, Modal and Subsystem.
Extension Mechanisms-Overview, Constraint, Tagged Value, Stereotypes, Tailoring UML.

Design Pattern

Introduction- Describing design pattern, catalogs, How to apply patterns, How to select and use patterns.
Creational Patterns- Abstract factory, Builder, Factory method, Prototype, Singleton
Structural Patterns- Adapter, Bridge, Composite, Decorator, Façade, Flyweight, Proxy.
Behavioural Patterns- Chain responsibility, Command, Interpreter, Iterator, Mediator, Observer, State, Strategy,

Template Method, Visitor.

Conclusion-What to expect from design pattern, The pattern community.

Principal of Object-Oriented Programming
- Software Evolution
- The Traditional approach
- Basic Concept of Object-Oriented Programming
- Benefits of OOP
- Object-Oriented Languages.

C++ Programming Basics
- Basic Program Construction
- Input/Output Using Cin & Cout
- Data Types
- Processor Directives
- Manipulatiors, Type Conversions, Arithmetic Operators & Library Functions.

Loops, Decisions, Structures
- Relational Operators

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Loops – for, while & do.
Decisions – if, if …. Else, switch Statements.
Logical Operators, Control Statements – break, continue, goto
Structured & Enumerated variables

Functions

Simple Functions
Function Prototyping
Overloaded Functions, Inline Functions, Variables & Storage Classes

Classes & Objects

Specifying a Class
Defining member Functions, Inline Functions
Private member Functions, Arrays within a Class
Memory Allocation for Objects, Objects as Function Arguments
Friendly Functions, Returning Objects
Const member functions & Pointer to Members

Constructors & Destructors, Operator Overloading

Constructors
Multiple Constructors in a Class
Copy Constructors & Copy Constructors
Destructors
Operator Overloadings & Type Conversions

Inheritance:: Extending Classes

Derived Class & Base Class, Derived Class Constructors
Overriding Member Functions
Class Hierarchies
Private & Public Inheritance, Multiple Inheritance
Containership: Classes within Classes

Pointers

Addresses & Pointers, Pointers and Arrays
Pointers & Functions
Pointers & Strings
Memory Management: New & delete Operators
Pointers to Objects, Pointers to Pointers

Virtual Functions & Polymorphism

Virtual Functions
Friend Functions
Static Functions
This Pointer

Files & Streams

Stream (Classes & Header Files)
String I/O
Character I/O
Object I/O

Templates & Exception Handling

Templates (Class, Functions, Member Function Templates)
Exception Handling
Elements of Java Programming (Introduction)

IT 506: ANALYSIS & DESIGN OF ALGORITHMS

FM – 50 Contact periods: 2 L. per week

Algorithms and Complexity – asymptotic notations, orders, worst-case and average-case, amortized complexity. Basic Techniques – divide & conquer, dynamic programming, greedy method, backtracking, branch and bound, randomization.

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Data Structures – heaps, search trees, union-find problems. Applications – sorting & searching, optimization problems, string matching. Graph Algorithms – BFS and DFS, connected components, spanning trees, shortest paths, max-flow. NP-completeness.

IT-507: **ANALOG & DIGITAL COMMUNICATION LAB.**

FM – 50 Contact periods: 3 P. per week

Experiments are based on the theory subject Analog & Digital Communication (IT 501).

IT-508: **MICROPROCESSOR LAB.**

FM – 100 Contact periods: 3 P. per week

Experiments are based on the theory subject Microprocessor (IT 502).

IT-509: **DATABASE MANAGEMENT SYSTEMS LAB.**

FM – 100 Contact periods: 3 P. per week

Experiments are based on the theory subject Database Management Systems (IT 503).

IT-510: **OBJECT ORIENTED PROGRAMMING LAB.**

FM – 100 Contact periods: 3 P. per week

Experiments are based on the theory Object Oriented Methodology & Programming (IT 505).

6th SEMESTER - INFORMATION TECHNOLOGY

HU-601: **PRINCIPLES OF MANAGEMENT**

FM – 100 Contact Periods : 3L+1T per week

As per the corresponding department's syllabi.

IT-601: **COMPUTER NETWORKS**

FM – 100 Contact Periods : 3L+1T per week

Introduction to Networks and Layered Architecture. Data Communication Concepts, Transmission Media and Topology.
Data Switching - Circuit, Message & Packet Switching. Data Link Protocols, Layer 2 switches and ATM switches.
Broadcast Wide Area Networks (WAN) , Local Area Networks (LAN) Topologies , IEEE 802.3 , 802.4 & 802.5 Protocols.
Fiber Optic Networks, Routing & Congestion Control - Routing Techniques X.25 Packet Layer, Internetworking,
Network Layer in Internet . Routers, Bridges and Gateways -- their practical implementations.

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Transport Protocols - Introduction to TCP/IP . UNIX networking concepts.. Backbone network. Session & Presentation Protocols.
Introduction to Application Protocols, Email, FTAM, Elements of Network Management and security, Conformance Testing and Interoperatibility .

IT-602: **TELECOMMUNICATION SYSTEMS.**

FM – 100 Contact Periods : 3L+1T per week

Introduction, elements of Tele traffic, Erlang's formula.
Switching techniques - Electronics switching, generic switch and Engset formula, SD/TD/STS networks. Hybrid time and space division switching.
Telephone networks- Signaling, DTMF techniques, transmission, digital transmission requirements.
Cellular Mobile Telephone System- Cell concepts, architecture, hardware procedures, GSM and CDMA standard, Data networks, Packet/Circuit Switching, LAN, MAN, WAN, ISDN, Broadband network, ATM concept and functionality.
Services- FAX, Cable TV, Video on demand.

IT-603: **MULTIMEDIA SYSTEMS.**

FM – 100 Contact Periods : 3L+1T per week

Introduction to Multimedia - application, goal and objectives.
Multimedia Configuration- Multimedia PC Workstation components, multimedia Platform , Multimedia Development Tool.
Multimedia Operating System- File system (TIFF, BMP, PCX, GIF etc.), System Architecture.
Multimedia Audio- Basic sound concepts, audio capture, music, speech processor, MIDI, wave files formats.
Multimedia Graphics- 2D/3D animation fundamentals, color modules, Video capture, Animation, Video processing AVO/AVI file formats.
Image compression techniques- JPEG, MPEG standard Hypertext, hyper media. Virtual Reality and multimedia.
Multimedia devices- Optical Devices, CD ROM, DVD, Scanners, CCD.
Multimedia Database-Image Representation, Segmentation, Similarity based retrieval, Image retrieval by color, Shape & texture, indexing –K-d-tree, R-tree, Video Content, Quad tree, Quarying, Video Segmentation, Indexing.

IT-604: **DIGITAL SIGNAL PROCESSING**

FM – 100 Contact Periods : 3L+1T per week

Discrete time Signals and Systems- Time and Frequency domain representation; Discrete Fourier Transforms. Linear time-invariant system; FIR and IIR Systems; Difference equations and solution, Stability, Frequency Response; Linear phase systems.
Realization of Digital Systems- Recursive and non recursive structures, Block Diagrams and signal flow graphs, Direct cascade, parallel, ladder and lattice realizations.
IIR Digital Filters- Approximation theory, Impulse invariant and bilinear transformations, Frequency transformations, Computer aided design techniques.
FIR Digital Filters- windows and Frequency sampling techniques, Computer aided design.
Discrete Fourier Transforms- Definitions, Properties, Circular convolution, Linear convolution.
FFT Algorithms- Basic DIT and DIF algorithms, Computational efficiency considerations.
Finite Word Length Effects- Quantization error and their effects on performance of digital signal processors.

IT-605: **ADVANCED COMPUTER ARCHITECTURE**

FM – 100 Contact Periods : 3L+1T per week

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Overview of von Neumann architecture: Instruction set architecture; The Arithmetic and Logic Unit, The Control Unit, Memory and I/O devices and their interfacing to the CPU; Measuring and reporting performance; CISC and RISC processors.

Pipelining: Basic concepts of pipelining, data hazards, control hazards, and structural hazards; Techniques for overcoming or reducing the effects of various hazards.

Hierarchical Memory Technology: Inclusion, Coherence and locality properties; Cache memory organizations, Techniques for reducing cache misses; Virtual memory organization, mapping and management techniques, memory replacement policies.

Instruction-level parallelism: Concepts of instruction-level parallelism (ILP), Techniques for increasing ILP; Superscalar, superpipelined and VLIW processor architectures; Vector and symbolic processors; Case studies of contemporary microprocessors

Multiprocessor Architecture: Taxonomy of parallel architectures; Centralized shared-memory architecture, synchronization, memory consistency, interconnection networks; Distributed shared-memory architecture, Cluster computers.

Non von Neumann Architectures: Data flow Computers, Reduction computer architectures, Systolic Architectures.

IT-606: **COMPUTER NETWORKS LAB**

FM – 100 Contact periods: 3 P. per week

Experiments are based on the theory Computer Network Lab (IT 601).

IT-607: **MUTIMEDIA SYSTEM LAB**

FM – 100 Contact periods: 3 P. per week

Experiments are based on the theory Multimedia Systems (IT 603).

IT-608: **DIGITAL SIGNAL PROCESSING LAB**

FM – 50 Contact periods: 3 P. per week

Experiments are based on the subject Digital Signal Processing (IT 604)

IT-609: **SYSTEMS PROGRAMMING LAB**

FM – 50 Contact periods: 3 P. per week

Experiments are based on the subject Digital Signal Processing (IT 504)

IT-610: **Viva-Voce-I**

FM – 50

th SEMESTER - INFORMATION TECHNOLOGY

IT-701: **SOFTWARE ENGINEERING**

FM – 100 Contact Periods : 3L+1T per week

Introduction, Software life-cycle models, Software requirements specification, formal requirements specification---axiomatic and algebraic specifications. Function-oriented software design

Information Systems and Software Engineering: information gathering, requirement and feasibility analysis, data flow diagrams, semantic modeling, process specifications, input/output design, process life cycle, planning and managing the project, design, coding, testing, implementation, maintenance.

Object-oriented design, UML, User interface design, coding and unit testing, integration and systems testing, Software quality--- SEI CMM and ISO-9001. Software reliability and fault-tolerance, Software maintenance. Computer-aided software engineering (CASE), Software reuse, Component model of software development.

Text Books:

Roger S. Pressman: Software Engineering A Practitioner's Approach, McGraw-Hill International Edition

IT-702: **DISTRIBUTED COMPUTING**

FM – 100 Contact Periods : 3L+1T per week

Introduction: Characterization of Distributed Systems, Network OSs vs. distributed Oss, Research and design issues
Interprocess Communication: Issues in message passing, Client-server communication
Remote Procedure Call: Design issues for RPCs, Case study: Sun RPC
Synchronization: Event ordering / synchronization, Centralized vs. distributed schemes
Group Communication: Ordered, reliable, and casual multicast, Group membership, Atomic group multicast, Virtual synchrony, Case study: ISIS, Service Replication / Reliable Services
Distributed Shared Memory: Shared memory, Consistency models, Design issues, Case studies: Ivy/Munin/Treadmarks
Distributed File Services: Model, Case study: NFS, Case study: AFS, Case study: CODA, Modern Systems: OceanStore
Distributed Naming Services: Names, addresses, routes, capabilities, Naming facilities, name distribution, name resolution, Migration
Security in Distributed Systems: Basic concepts of Cryptographic techniques, Digital Signatures, Digital Certificates
Clock Synchronization: Basic Concepts, Internal and External Clock Synchronization, Lamport's Logical Clock, Vector Clock

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***IT-703:* BROADBAND COMMUNICATIONS**

FM – 100 Contact Periods : 3L+1T per week

Fiber Optic Communication Principle, Types of Optical Fiber, Single Mode Step Index, Multimode Step Index and Grade Index Fiber. Multiplicative Noise in Optical Fibers. Optical Source Detector, Transmitters and Receivers.

Cellular Concepts of Mobile Communication, Propagation Effect, Fading Multipath Channel, Delay

Spread and Doppler Spread, Diversity Techniques. Mobile Radio, Mobile Telephone System.

Historical Development of Satellites. Communication Satellite Systems, Orbiting Satellite, Satellite Frequency Bands, Satellite Multiple – Access Formats. Satellite Channels, Transponders, Earth Station, Direct Broadcast Satellite (DBS).

***IT-704:* WEB TECHNOLOGY**

FM – 100 Contact Periods : 3L+1T per week

Introduction Internet Architecture, PC to LAN, LAN to Internet Connections, Host name & Top level domains IP addresses DNS Mail addresses , URLs File names , types & extensions Socket and Client Server Applications Internet Protocols SMTP , HTTP , FTP , Telnet

Evolution of www, Proxy, Firewall, Domain name selections and registration, Web site management, web Page design, Internet programming language- JAVA, CGI, PERL, CORBA.
Introduction to Intranet Technology - Email, Search Engines, Hardware and Software requirement for Intranet.

***IT-705:* ELECTIVE-I**

FM – 100 Contact Periods : 3L+1T per week

VLSI Design

Introduction to VLSI technology, Complexity of design and need for automation , Placement and routing .

PLA's : folding and partitioning , Physical layout design ,Design rule checking , Simulation ,Testing and Design for testability , Reliability and yield analysis.

Familiarity with CAD tools ,VHDL .

FPGA Architecture , design methodologies and tools .

Typical FPGA based Design exercises .

***IT-706:* SOFTWARE ENGINEERING LAB**

FM – 100 Contact periods: 3 P. per week

Development of requirements specification, function oriented design using SA/SD, Object-oriented design using UML, test case design, and implementation using Java and testing.

***IT-707:* DISTRIBUTED COMPUTING LAB**

FM – 100 Contact periods: 3 P. per week

Experiments are based on the theory Distributed Computing (IT 702).

IT-708: **WEB TECHNOLOGY LAB**

FM – 100 Contact Periods : 3P. per week

Development of Web site
Creation of Dynamic Web Pages using different tools
Web Programming languages such as JAVA, ASP
Introduction to PERL
Development of an experimental search engine

IT-709: **PROJECT PRELIMINARIES**

FM – 50 Contact Periods : 3P. per week

IT-710: **VIVA-VOCE-II**

FM – 50

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8^{th} SEMESTER - INFORMATION TECHNOLOGY

IT-801: IMAGE PROCESSING & PATTERN RECOGNITION

FM – 100 Contact Periods : 3L+1T per week

Introduction to Image Processing- Areas, problems and applications viz. Image representation, Image Enhancement & Feature Extraction, Image Analysis and pattern Recognition, Image compression.
Mathematical Preliminaries **-Review of various notation, definitions w.r.t. linear shift invariant systems, fourier transforms, matrix theory, kronecker products, random signals and fields, spectral density function, estimation theory.**

Image Representation- Monochrome and color image models, image file formats. **Discrete 2-D linear processing and image transforms –**Superposition, convolution, 2D orthogonal and unitary transforms their properties. Examples like 2D FFT, cosine, sine, hadamard .
Image enhancement- Point operation viz. Contrast stretching, clipping, thresholding etc. histogram modeling spatial operations like low pass filtering, median filtering, directional and other smoothing techniques, zooming Transform operations like root & homomorphic filtering.
Image analysis and pattern recognition- Spatial feature extraction, edge detection, boundary extraction, region representation and segmentation, shape features, textures. Pattern recognition and training using learning , Classification algorithm Kmeans, Application like character recognition, signature verification ,Clustering etc.
Image data compression- Image data compression requirements and types, Statistical and spatial compression techniques like RLE, PCM, Huffman coding, contour coding etc. Predictive coding like DM, DPCM. Transform coding algorithm-DCT, Concept of Hybrid coding, (Quantization and sampling, Uniform quantizer and non uniform quantizer, Concept of JPEG and MPEG standards)

IT-802: ARTIFICIAL INTELLIGENCE

FM – 100 Contact Periods : 3L+1T per week

Scope of AI

- Games, Theorem Proving
- Natural Language Processing
- Vision and Speech Processing
- Expert systems
- AI techniques-search, Knowledge, Abstraction

PROLOG: AI Programming Language

- Facts, Questions, Variables,
- Conjunctions, Rules
- Prolog syntax and data structures
- Lists and trees
- Use of CUT and fail
- Input and Output
- Built-in predicates

Problem Solving
State space search: production Systems Search space control: depth first, breadth first
earch. Heuristic search – Hill climbing Best first searchBranch and bound. A* and AO* algorithms Constraint satisfaction Minmax search-Alpha-Beta pruning

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Knowledge Representation

Predicate Logic (First order logic and WEFs, Unification, Resolution, Limitations)Rule based systems (Forward reasoning: Handling conflict resolution, Backward reasoning)Structured knowledge representation (Semantic networks, Frames
and seripts. Object oriented representations)

Learning

Concept of learning . Learning by Induction Analogy Explanation-Based Learning Discovery. Introduction of Neural Networks .

Expert Systems

Need and justification for expert systems
Expert system architectures (Rule-based systems, Non production systems, Use of certainty factors) Knowledge acquisition Case studies: MYCIN, RI

Handling Uncertainty and Nonmonotonic Reasoning

Probabilistic reasoning (Bayes Net, Dempster Shafer theory) Fuzzy Logic, Default logic.

Introduction to Natural Language Processing

***IT-803:* MOBILE COMPUTING**

FM – 100 Contact Periods : 3L+1T per week

Cellular Networks: Channel allocation, Multiple access, Location management, Handoffs.
Wireless Networking: MAC protocols, Routing, Transport, Ad-hoc networking.
Applications: Mobility adaptations, Disconnected operations, Data broadcasting, Mobile agents.
Others: Security, Energy efficient computing, Impact of mobility on algorithms.

***IT-804:* ELECTIVE II (DEPARTMENTAL)**

FM –100 Contact Periods : 3L+1T per week

***IT-XXX:* ELECTIVE III (NON DEPARTMENTAL)**

FM –100 Contact Periods : 3L+1T per week

***IT-805:* IMAGE PROCESSING & PATTERN RECOGNITION LAB**

FM – 100 Contact periods: 3 P. per week

Experiments are based on the theory Image Processing & Pattern Recognition (IT 801).

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IT-806: **ARTIFICIAL INTELLIGENCE LAB**

FM – 50 Contact periods: 3 P. per week

Experiments are based on the theory Artificial Intelligence (IT 802).

IT-807: **ELECTIVE II LAB**

FM – 50 Contact periods: 3 P. per week

Experiments are based on the theory Elective II (IT 804).

IT-808: **PROJECT THESIS**

FM – 150 Contact Periods : 6P. per week

IT-809: **VIVA-VOCE III**

FM – 100

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DEPARTMENT OF MECHANICAL ENGINEERING

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DEPARTMENT OF MECHANICAL ENGINEERING

APPROVED SYLLABUS for UNDERGRADUATE (B.E.) COURSE

3rd Semester Mechanical Engineering

ME 301 BASIC THERMODYNAMICS

Semester Examination : Contact Periods : (3L+ 1 T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 70. **Full Marks – 30.**

Basic concepts. Thermodynamic equilibrium. Quasic-static process. Zeroth law. Work and heat interactions. First law of thermodynamics: Statement, corollaries and application to closed and open systems. Steady and variable flow processes. Second law statements. Reversibility. Carnot's theorem. Absolute temperature scale. Inequality of Causius. Entropy principle, available energy. Availability and irreversibility. Properties of pure substances, phase equilibrium diagrams. Properties of ideal gas and gas mixtures. Reactive mixtures. Air – water vapour mixture.

ME 302 GENERAL MECHANICAL ENGINEERING –I (for MT)

Semester Examination : Contact Periods : (3L+ 1 T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 70. **Full Marks – 30.**

Basic Machining Process :
Lathe : Specifications, types, functions of various parts, head stock gear arrangement, apron mechanism, Lathe operations : turning, taper turning, thread cutting, facing, knurling, chamfering etc.
Milling Machine : types, different milling operations, indexing methods.
Shaping and Drilling Machines : specifications, types, function of various parts, different operations.
Internal Combustion Engines : Working principles of Petrol and Diesel engines, Otto, Diesel and Dual cycles, power calculation and efficiencies.
Material Handling : various types of conveyors and cranes, unit load handling – robots.

ME 303 HEAT POWER (for MN)

Semester Examination : Contact Periods : (2L+ 1 T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 35. **Full Marks – 15.**

Fundamental concepts : Thermodynamic System, surroundings, properties, process, cycle, internal energy, enthalpy, flow work, Zeroth Law of Thermodynamics, heat work, entropy.
First Law of Thermodynamics : Statement, applications to open and closed system.
Ideal and real gases – Equation of State, mixture of gases, non-flow reversible processes.
Steam : Definition of terms, properties, property table and charts.
Second Law of Thermodynamics : Difference with the First Law and the two statements.
Power cycles : Carnot, Otto, Diesel, Dual, Joule and Rankine cycles.

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Boilers : Classifications, mountings and accessories, draught, losses and efficiency.
Steam engines : Classifications, indicator diagram, power, efficiency, governing.
Principle of steam turbines, condensers, and cooling towers.
I.C. Engines : Classifications, two and four-stroke engines, fuels, carburetor, injector, power and efficiency : engine systems – cooling, lubrication, governing, starting.
Reciprocating compressor : Single and multi-staging, power and efficiencies.
Refrigeration cycles : Definition heat engine, Refrigerator, and heat pump, C.O.P., reversed Carnot cycle, air refrigeration and vapour compression cycles.

ME 304 ELEMENTS OF MECHANICAL ENGINEERING (for CS)

Semester Examination :	Contact Periods : (2L)
Time-3 hrs.	**Internal Assessment :**
Full Marks – 35.	**Full Marks – 15.**

Consideration of requirements of Machine Design, standardization of preferred numbers and Renard series, fits and tolerance, material estimation, riveted joint, knuckle joint, welded joint, flat belt, screw and nuts.

Gear drive, mechanisms, governors, fly wheel, mechanical vibration.

ME 351 BASIC MECHANICAL ENGINEERING LAB

Full Marks : 50 **Contact Period : (2S)**

1. Study of 4-stroke Petrol Engine.
2. Study of.2-stroke Petrol Engine
3. Study of 4-stroke C.I. Engine
4. Study of Cochran Boiler.
5. Study of Babcock-Wilcox Boiler.
6. Calibration and use of Planimeter.
7. Calibration and use of Vacuum Gauge.

ME 352 GEN. MECHANICAL ENGINEERING - I LAB (for MT)
Full Marks : 50 **Contact Period : (3S)**

1. Study of 4-stroke Petrol Engine Model.
2. Study of 2-stroke Petrol Engine Model.
3. Study of Cochran Boiler Model.
4. Study of Babcock-Wilcox Boiler Model.
5. Trial of a Reciprocating Air Compressor.
6. Study of 4-stroke C.I. Engine.
7. Measurement of Air Flow by standard Orifice Meter.

ME 353 HEAT POWER LAB. (for MN)
Full Marks : 50 **Contact Period : (2S)**

1. Study of Smoke Tube Boiler.
2. Study of Water Tube Boiler.

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3. Study of 4-stroke C.I. Engine
4. Study of 4-stroke Petrol Engine.
5. Calibration and use of Planimeter.
6. Measurement of Air flow by standard Orifice Meter.
7. Calibration and use of Vacuum Gauge.
8. Trial of a Reciprocating Air Compressor.

4th Semester Mechanical Engineering

ME401 Introduction to Mechanical Design

Semester Examination : Contact Periods : (3L+ 0T)
Time-2 hrs. **Internal Assessment :**
Full Marks – 35. **Full Marks – 15.**

Concept of engineering design and mechanical design. Engineering design is an applied decision theory. Basic steps in mechanical design. Standardization, Preferred numbers, Derived series of preferred numbers. Definitions of Limits, Fits and Tolerance, Types of Fits, Tolerance with respect to Indian Standard, Calculation examples, Interchangeability, Surface Roughness and its designation on drawing. Stress concentration, Methods to reduce stress concentration. Factor of safety.
Basic approach to static strength design. Design of Cottered Joint, Knuckle Joint and Hookes Joint. Types of welded joints and their symbols. Design of riveted joints and simple welded connections under concentric loads only. Design of flat belts.

ME402 Applied Thermodynamics

Semester Examination : Contact Periods : (3L+ 1 T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 70. **Full Marks – 30.**

Gas power cycles: Carnot, Otto, Diesel, Duel, Stirling, Ericsson, Brayton.
Vapour power cycles: Carnot, Rankine. Effect of steam parameters on performance.
Refrigeration cycle: Reversed carnot cycle, Air refrigeration, Vapour compression refrigeration.
Boiler: Fire tube and water tube boiler, mounting and accessories, draft systems, performance.
Reciprocating compressor: single stage and multi-stage compression, compressor with clearance, power and efficiency.
Rotary compressors (positive displacement type): Roots blower, vane type compressors, screw type compressors.
Rotary compressor (Dynamic type): Centrifugal and Axial compressors.
Introduction to nuclear power generation.

ME403 Engineering Materials & Processes

Semester Examination : Contact Periods : (3L+ 1 T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 70. **Full Marks – 30.**

Mechanical properties and their testing. Engineering and true stress-strain diagram, ductile and brittle fracture, toughness, endurance limit and fatigue testing, creep.
Phase diagrams: solid solutions, binary alloy system, lever rule, Iron-carbon equilibrium diagram, TTT diagrams.
Heat treatment: Annealing, normalizing, tempering, hardening (case hardening and surface hardening).

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Engineering materials: A brief overview on metals, alloyed steel, nonferrous alloy, ceramics, polymers and composite materials.

Casting: various types of patterns and allowances, mould materials and their properties: strength, permeability and hardness, moulding. Basic principles of solidification. Cupola: terminology, charge calculations. Brief descriptions of the special casting processes: shell moulding, investment casting, die casting and centrifugal casting. Casting defects.
Joining: Welding, brazing and soldering.
Metal forming processes: Recrystallisation temperature, hot and cold working. Rolling, forging, drawing, extrusion, metal forming defects.

ME404 Measurement and Control

Semester Examination : Contact Periods : (3L+ 1 T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 70. **Full Marks – 30.**

Similarity, errors and dynamic characteristics of measuring instruments, Measurement of strains, strain gauge rosette. Assessment of stress concentration by Photoelasticity, Moire, Caustics, Grid method and Brittle coating method. Measurement of pressure, force and torque and temperature. Concept of censors and application. Measurement of plane area – theory and operation of planimeters.
Metrology: Introduction to limits and fits, gauge design, interferrometry, surface finish measurement.
Measurement of flow systems: pitot tube, hot-wire anemometer, laser doppler velocimeter; optical techniques for field measurement, image processing, volume average measurement, uncertainty analysis.
Modelling of systems via transfer function – First order and second order systems – Open and closed loop control systems – Time domain and frequency domain reopens, Bode plots, phase margin and gain margin. Design of compensation (lag and lead compensation); Design of controller – PI, PD, PID controllers. Stability of systems, Different theories of BIBO stability and asymptopic stability – stability criteria, Kharitonov criteria, Nyquist criteria. Statevariable modelling of systems – Observability and controllability.

ME405 Gen. Mechanical Engg - II (for MT)

Semester Examination : Contact Periods : (3L+ 1 T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 70. **Full Marks – 30.**

Principles of Metal Cutting : mechanics of metal cutting, types of chips, cutting tools, tool geometry, shear angle and shear strain, tool materials, forces on cutting tool (Merchant's Circle Diagram), tool failure, tool life, machinability, cutting fluid.
Introduction to Metal Forming Process : Difference between metal cutting and metal forming operation, cold and hot working process, various metal forming operations – forging, drawing, extrusion, rolling, coining, bending, punching & blanking etc.

Design of Machine Elements : Riveted joints, bolted joints, shafts, keys and couplings, belt drives.

ME451 Applied Thermodynamics Lab.

(Sessional Subject)

Full Marks – 50. Contact Periods : 3S

Sessional - Lab based on the syllabus of APPLIED THERMODYNAMICS (ME 402)

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DESIGN OF MACHINE ELEMENTS–I (ME 501)

Design of bolted joints for pressure vessels for static and fatigue loading. Design of riveted, bolted and welded joints under both in-plane and out of plane eccentric loads. Design of power transmission shafts under various loading conditions. Design of keys, key ways and splines. Design of flexible coupling. Design of helical compression and leaf springs. Design of spur and helical gears. Specification and selection of V – belts.

INTERNAL COMBUSTION ENGINE (ME 502)

Air standard cycle. Fuel air cycle. Actual cycle and losses. Valve timing diagram for 2 stroke & 4 stroke SI and CI engines. Testing and performance characteristics and heat balance.

Normal and abnormal combustion in SI and CI engines. Pre-ignition and Auto-ignition. Detonation and Knocking. Design and operating parameters affecting engine performance.

Fuel-feed systems: curburator, fuel pump & injector. Egnition system: Battery and Magneto.

Economy and emission: Super charging and governing.

Nozzles: Flow through nozzles, critical pressure ratio, nozzle efficiencies, off design operation. Super-saturation in steam nozzles.

Gas Turbine and Jet propulsion: Practical gas turbine cycle, modification to the basic cycle, combustion.
Polytropic or small stage efficiencies in jet propulsion.

HEAT TRANSFER (ME 503)

Conduction: Theory of heat conduction; Thermal conductivity, Derivation of heat conduction equation in three dimensions. Solution for steady 1-D conduction with and without heat generation, composite slabs, cylinders, critical thickness of insulation. Steady 2D conduction without heat generation and simple boundary conditions. Heat transfer from extended surfaces: fins and spines. Unsteady heat conduction, negligible internal thermal resistance, cases with practical exercises. Solution of I-D unsteady conduction equation. Radiation: Theory of thermal radiation, electromagnetic spectrum, Planck's law, Wien's displacement law, Stefan Boltzmann equation, Concept of black and gray bodies, Kirchoff's law. Heat exchange between black and gray bodies without participating media, radiation shields, re-radiation surfaces, view factors and view factor algebra. Equivalent emissivities of grooved surfaces, Electrical network analogies. Simple problems of combined radiation and convection, Radiation error in thermometry. Convection: Recapitulation of hydrodynamic equations of boundary layer theory, analysis of thermal boundary layer by control volume method, Laminar heat transfer over flat plate. Fully developed heat transfer through smooth pipes. The cases of constant heat flux and constant wall temperature boundary conditions. Dimensional analysis: correlations of heat transfer in turbulent flow, use of hydraulic diameter. Free convection heat transfer phenomena. Heat exchangers, log mean temperature difference, effectiveness and NTU.

MACHINE TOOLS AND METAL CUTTING (ME 504)

Concept and definition of machining and machine tools. Concept of generatrix and directrix. Kinetic chains and structures of conventional machine tools. Various mechanisms for transformation and transfer of motion in machine tools. Differential mechanisms. Classification of machine tools. Fixed automation. Machining processes in lathe, shapers, planers. Accuracy-Alignment-Inspection of machine tools.

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Metal cutting: Tool geometry, mechanism of chip formation, mechanics of machining, cutting temperature and cutting fluid. Failure, wear and life of cutting tools. Basic concepts of on-line tool condition monitoring. Tool materials.

KINEMATICS OF MECHANISMS (ME 505)

Basic theories of mechanisms: Kinematic pairs, Degrees-of-freedom, Kinematic chains, Four-link planer mechanisms, Kinematic inversions, Mobility and range of motion – Grublers criterion, Grashoft's criterion.

Kinematic analysis of planer mechanisms: Displacement, velocity and acceleration analysis, instantaneous centre of velocity, Aronhold – Kennedy theorem of three centres.

Dimensional synthesis: Three position, four position synthesis, branch and order defects.

Dynamics analysis of planer mechanisms: Rigid body dynamics in a plane, virtual work, D'alembert's principle, Dynamic motion analysis, Dynamic pole analysis.

Cam: Classifications, analysis of follower motion, profile synthesis.

Gears and gear trains: Fundamental law gearing, involute spur gear, helical, spiral, bevel, hypoid gears, epicyclic gear trains.

Computer aided analysis and synthesis of mechanisms:

6th Semester Mechanical Engineering

DESIGN OF MACHINE ELEMENTS – II (ME 601)

Force analysis and design of bevel (with straight and spiral teeth) and worm gears. Mounting and selection of rolling contact bearings: ball bearing, plain and taper roller bearings. Design of friction clutches and brakes. Concepts and applications of optimization techniques in machine design.

BOILER AND STEAM TURBINE (ME 602)

Boiler: Modern high pressure boilers; Water wall. Superheaters, Reheater, Economisers and Air preheaters. Circulation. Draft system, Losses and Efficiency.
Advanced steam cycle reheat and regeneration. Binary vapour cycle. Combined cycles. Ideal working fluid. Process heat and power.
Turbine: Impulse and reaction turbines, compounding of turbines. Optimum velocity ratio; Reheat factor and condition line. Losses in steam turbines. Steam turbine governing.
Condenser: Important types. Air-source, its effect and removal, surface condensers, its calculations.
Cooling tower: Classification. Principles of operation, circulation. Wet cooling Tower & cooling fans.

INDUSTRIAL ENGINEERING AND MANGEMENT (ME 603)

Historical Development of Industrial Engineering, Facility location, Plant layout, Production planning and control, Work-study, Incentive plans, Break-even analysis, Maintenance and reliability, Replacement analysis, Value engineering, Material handling, Entrepreneurship.

MANUFACTURING TECHNOLOGY (ME 604)

Milling machine: specifications, types, functions of various parts, various operations, indexing methods – simple compound and differential indexing. Gear cutting.
Grinding machine - types of grinding machines, various grinding operations; Grinding wheels, preparation for wheel operation.
Multipoint Machining - Broaching and Reaming.

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Finishing Operations - Honing and Lapping.
Fundamentals of plasticity, yield and flow, anisotropy, instability, limit analysis, slipline field theory. Metal forming processes: Types of forming, mechanism of forming. Fundamentals of metal working processes – rolling, forging, extrusion, drawing of rod, wires and tubes. Sheet metal forming.
Modern welding techniques - Tungsten Inert Gas welding and Metal Inert Gas welding, submerged arc welding, plasma arc welding, powder metallurgy.

NUMERICAL METHODS IN ENGINEERING (ME 605)

Solution of algebraic and transcendental equations: fixed point iterative methods; method of iteration, order of convergence, method of bisection, regulai-falsi method, Newton-Raphson method. Roots of polynomial equation by Lobachevsky-Graeffe's method, Bairstow's method. Solution of system of nonlinear equations by Newton-Raphson method.

Solution of system of linear algebraic equations: direct methods – Gaussian elimination method, Gauss Jordan method, LU decomposition technique (Doolittle's and Crout's method), Cholesky decomposition for symmetric matrices, matrix inversion. Ill conditioned systems – condition index and condition number. Iterative methods – Gauss Seidel method, convergence of the iterative method.
Numerical Integration and Differentiation: Trapeziodal, Simpson's and Romberg's methods. Degree of precision, Newton Cotes formula, composite forms, Gaussian quadrature using Legendre polynomials.

Curve fitting and interpolation: Linear regression, Matrix formulation of the least square procedure for linear forms. Weighting for least square method, curve fitting with polynomials, Fourier series and exponential function. Interpolation; curve fitting and interpolation with a cubic spline.

Numerical solution of ODE: solution of initial value problems by single-step and multi-step methods – Runge-Kutta method, Adam-Bashforth-Moulton and Millne's method. Solution of boundary value problem – Finite Difference method.

Numerical solution of PDE: methods of finite difference and relaxation technique for solving elliptic and hyperbolic equations.

DYNAMICS OF MACHINES AND VIBRATION (ME 606)

Balancing: Static and dynamic balancing, Rotating masses in one or parallel planes, Balancing of reciprocating masses - multi-cylinder in-line engines, V, multi-V and radial engines, Balancing Machines.

Vibration analysis: Simple harmonic motion, degrees of freedom, Free and forced vibrations without and with damping for single degree of freedom systems. Torsional vibration, Problems of two degrees of freedom, Vibration of beams, Energy method of vibration analysis, Vibration measurements, Vibration transmissibility and isolation.

Critical speed of rotating shafts - higher critical speeds.
Precession, Gyroscope - their applications.

7thSemester Mechanical Engineering

TRIBO-DESIGN OF MACHINE ELEMENTS (ME 701)

Definition of Tribology, Economic aspects of Tribology – Lubrication, Friction and Wear. Engineering Surfaces, Surface Topography, Contact Mechanics, Contact of Two Rough Surfaces, Sources of friction, Wear Mechanisms, Basic equations of the theory of lubrication – its solution for

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idealized and finite bearings, Lubrication regimes - Boundary, hydrodynamic, hydrostatic, elastodydrodynamic lubrication, Properties of lubricants and additives, Wear resistant materials

OPERATIONS MANAGEMENT (ME 702)

Basic probability theory and statistical methods, Forecasting, Linear programming, Transportation and assignment problems, Waiting line theory, Game theory, Project management, Inventory control, Materials requirement planning, MRP-II, Scheduling and sequencing, Statistical Quality Control, Total Quality Management.

REFRIGERATION AND AIR-CONDITIONING (ME 703)

Methods or refrigeration: Air refrigeration cycle. Thermodynamic cycles of single and multistage vapour compression refrigeration; vapour absorption refrigeration systems. Thermoelectric refrigeration. Properties and designation of refrigerants.
Compressors, condensers, expansion valves and evaporators. Ice plant. Cold storage. Introduction to cryogenics.
Psychrometry and psychrometric processes. Evaporative collers. Cooling load calculations. Duct design and distribution of conditioned air. Air-conditioning control. Automobile air-conditioning. Packaged and central air conditioning systems.

AUTOMATION AND COMPUTERIZED MANUFACTURING (ME 704)

Gear Hobbing. Capstan and Turret lathe. Single-spindle and multi-spindle automatic lathes. Machining centre.
NC, CNC Machines: Types, Axis definition, Tool offset, CNC programming.
Flexible Manufacturing Systems (FMS) and Computer Integrated Manufacturing (CIM): Configuration and application.

ELECTIVE – I

INTRODUCTION TO MECHATRONICS (ME 705/1)

Introduces the technologies involved in mechatronics (Intelligent Electro-Mechanical Systems) and the techniques necessary to apply this technology to mechatronic system design.

Electronics (A/D, D/A convertors, op-amps, filters, power devices); software program design, event-driven programming; hardware and DC stepper motors, solenoids, and robust sensing. Lab component of structural assignments. Large and open-ended team project. Limited enrolment.

COMPUTATIONAL NANOTECHNOLOGY (ME 705/2)

Current research topics in computational nanotechnology. Overview of atomistic modelling methods for nanoscale materials science and device technology: classical molecular dynamics, Monte Carlo simulations, and quantum mechanical simulations. Nanotube device modelling: chemical and biosensors, electromechanical sensors and actuators, nanotransistor, nanotube polymer composites. Atomistic simulations of nanomechanics of materials: nanocrystalline solids, thin films, patterned nanostructures. Design of novel nanodevices with fullerenes and biomolecules: multi-walled fullerenes and nano peapods for quantum devices, biomolecule-solid surface functionlization. Nano particles and clusters: novel electronic and optical devices.

COMPUTER INTEGRATED MANUFACTURING SYSTEMS (ME 705/3)

Software tools for CIMS. Basics of DBMS, DSS, distributed computing and LAN and FAN. Shop floor automatic identification techniques, CAD/CAM. Industrial robotics: Single and mixed product manufacturing, robotized assembly. GT applications. FMS: analysis. Automated material handling.

ADVANCED SYSTEM DYNAMICS AND CONTROL (ME 705/4)

Analytical and graphical descriptions of state-determined dynamic physical systems; time and frequency domain representations; system characteristics-controllability, observability, stability; linear and nonlinear system responses. Modification of system characteristics using feedback. State observers, Kalman filters. Modeling/performance trade-offs in control system design. Emphasis on application of techniques to physical systems.

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FATIGUE, CREEP AND FRACTURE (ME 705/5)

Fatigue: Nature of fatigue, Types of fatigue loading, Simple stress fatigue properties with fixed and varying amplitude; combined stress fatigue properties. Notch sensitivity. Factors influencing fatigue strength, fatigue tests. Utilization of fatigue properties in design.
Creep: Creep stress-time-temperature relations for simple tension and combined stresses. Recovery creep and relaxation, Testing techniques representation of test data.
Fracture: Basic modes of fracture, Introduction to the theories of Linear Elastic Fracture Mechanics. Griffith's theory of brittle fracture, Irwin's theory of fracture in elastic-plastic materials, stress intensity factors. Fracture toughness testing and interpretation of test data. Fracture of composite materials. Damage mechanics and experimental analysis.

WAVE PROPAGATION (ME 705/6)

Theoretical concepts and analysis of wave problems in applied mechanics with examples chosen from elasticity, acoustics, geophysics, hydrodynamics, blood flow, and non-destructive evaluation. Progressive waves, group velocity and dispersion, energy density and transport. Theory of characteristics. Reflection, refraction and transmission of plane waves by an interface. Mode conversion in elastic waves. Rayleigh waves. Waves due to a moving load. Scattering by a two dimensional obstacle. Reciprocity theorems. Parabolic approximation. Waves on the sea surface. Capillary-gravity waves. Wave resistance. Radiation of surface waves. Internal waves in stratified fluids. Waves in random media.

FINITE ELEMENT ANALYSIS IN ENGINEERING (ME 705/7)

Basic principles of continuum mechanics and finite element methods, modern application to solution of practical problem in solid, structural, heat and mass transfer and other field problems. Kinematics of deformation, strain and stress measures, constitutive relations, conservation laws, virtual work and variational principles. Weighted residual method and Galerkin techniques in finite element formulation. Discretization of governing equations using finite element methods. Solution of central problems using existing computer programs.

FUNDAMENTALS AND MODELING IN COMBUSTION (ME 705/8)

Fundamentals and modelling of physical gas dynamics and combustion using analytical and numerical methods. Conservation equations of reacting flows. Chemical thermodynamics and kinetics. Non-equilibrium flow. Detonation and boundary layers. Ignition, flammability, and extinction. Premixed and diffusion flames. Combustion instabilities. Supersonic combustion. Turbulent combustion. Fire, safety, and environmental impact.

SOLAR ENERGY THERMAL PROCESSES (ME 705/9)

Fundamentals of solar radiation Review of fluid mechanics and heat transfer. Flat plate collectors, Focussing collectors, Solar water and air heating systems, solar cooling and dehumidification, solar energy storage, solar electric power, solar distillation of saline water and solar stills, solar cookers, solar pond and its thermal performance.

NC/CNC MACHINE TOOLS (ME 705/10)

Basic Architecture of NC and CNC Machine Tools. Classifications of difference CNC Systems. Data Processing Unit (DPU): Interpolator Hardware and Software, Machine Control Unit (NCU), Sensors and Actuators in CNC Machine Tools – Encoders, Stepper Motor, Machine Drive Unit (MDU), Control Software, Adaptive Control in CNC Machine Tools, Part Programming Fundamentals.

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Introduction to the Finite Element Method (ME 705/11)

Basic concepts of the Finite Element Method (FEM). FEM solution of standard discrete systems: 1-D springs and plane truss. Generalization of the finite element concepts – weighted residual, Galerkin method and variational approaches. FE formulation of steady state field problems (governed by 1-D and 2-D differential equations) such as heat conduction, fluid flow etc. Shape functions for triangular, rectangular elements. Isoparametric elements. Application of FEM to structural mechanics problems: plane stress, plane strain and axisymmetric stress analysis. Natural coordinates, numerical integration. Computer implementation of finite element procedures.

Composite Materials (ME 705/12)

Definition of fibre reinforced composite materials with examples, benefits properties and applications. Fabrication processes. Rules of mixtures, Halpin-Tsai equations for effective moduli of a continuous fibre-reinforced lamina.

Stress-strain relationship of a continuous fibre-reinforced lamina: both specially and generally orthotropic type. Theories of failure for continuous fibre-reinforced lamina: maximum stress, maximum strain, Tsai-Hill and Tsai-Wu criteria. Analysis of lamina hygrothermal behaviour. Mechanical testing of composites.

Analysis of composite laminates with classical lamination theory. Extensional, Coupling and Bending stiffness matrices. Stiffness characteristics of selected laminate configurations: symmetric, antisymmetric and quasiisotropic types. Determination of stresses and strains in different plies. Residual stresses in laminae due to hygrothermal effects.

8th Semester Mechanical Engineering

DESIGN OF MECHANICAL SYSTEMS (ME 801)

Concepts of Mechanical systems design, Design of a speed reduction gear box, Design of Cam systems - profile determination and force analysis, Design of I.C. engine systems – cylinder, piston, connecting rod, crank shaft, etc. and Design of Machine frame and mounting for vibration isolation.

NON-TRADITIONAL MANUFACTURING AND NANO-TECHNOLOGY (ME 802)

New technologies: AJM, WJM, EDM, ECM, USM: working principle, components of set up, field of application, Parameters affecting machining characteristics, Material removal mechanism.

Nano-machining or processing systems of nanometric accuracies and sub-nanometric processing resolutions.

Processing unit, breaking stress and processing energy densities, Mechanism of materials processing based on imperfections or defects in materials, Nano-mechanical processing of atom clusters and sub-crystal grain units, Nano-positioning system applications of nano-technology, Energy beam processing of materials.

POWER PLANT ENGINEERING (ME 803)

Thermal: Site selection and Plant layout, operation and control, coal handling systems. Ash handling systems, Dust collecting devices, Water chemistry.

Hydel: Hydro electric power plant. Site selection and plant layout, classification. Storage type power plant pump storage power plant Mini and Micro Hydel plants. Components.

Diesel: Site selection and Plant layout. Diesel plant components and auxiliaries. Performance at varying loads. Application of diesel plant.

Gas Turbine: Site selection and plant layout. Performance at part load and full load. Application of Gas Turbine plant.

Computer Aided Design of Mechanical Systems **(ME-851)**

1. Basic concepts of solid modelling of parts using solid works:
   - Creating complex planer profiles on a plane.
   - Creating solid prismatic body by extrusion of plane closed figure.
   - Creating cut-extrusion.
   - Creating holes.
   - Creating axisymmetric bodies by mirroring.
   - Creating patterned features.
   - Chamfering and rounding of edges and corner.
   - Dimensioning and editing features.
2. Basic concepts of assembly of parts.
3. FEM analysis of simple parts using ANSYS.

ELECTIVE – II

TURBOMACHINES (ME 804/1)

Introduction to engineering applications involving compressible flow: aircraft propulsion, rocket propulsion, power generation; application of mass, momentum, energy and entropy balance to compressible flows; variable area isentropic flow, normal shock waves, adiabatic flow with friction, flow with heat addition. Operation of flow systems: the propulsion system. Introduction to turbomachinery: pumps, compressors, turbines. Angular momentum analysis of turbomachine

performance, centrifugal and axial flow machines, effect of blade geometry, dimension-less performance of turbomachines; hydraulic turbines; steam turbines; wind turbines. Compressible flow turbomachine: the aircraft engine.

CIRCULATING FLUIDIZED BED TECHNOLOGY (ME 804/2)

Fluidisation and its application in industry; Particle characteristics and hydrodynamics of fluidisation. Heat transfer in fluidised beds: gas-to-particle, bed-to-wall heat transfer, heat transfer to tubes immersed in fast beds, heat transfer and part load operations.

Combustion, emissions and their control. Design considerations, gas solid separators and design of CFB components. Management of solid residues. Material issues and integrated gasification combined cycle plant.

AUTOMOBILE ENGINEERING (ME 804/3)

Engine: Valves and cam shafts, cam shaft chain, belt and gear train drives, engine balancing and vibration, combustion chamber design and performance, introduction and exhaust systems, supercharging systems, carburetted fuel systems, diesel fuel injection pump systems, cooling and lubrication system, emission control. Modern multipoint fuel injection (MPFI) engines.

Automotive Electrical and Electronics Systems: Automotive electrical system, battery, starting system, contact-point ignition system, electronic ignition system. Automotive Power Trains: Automotive clutches, drive lines and universal joints, differential and drive axels.

Automotive Chains: Spring and spring system, automotive steering system, automotive brakes, tires and wheels, air-conditioning system.

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COMPOSITE MATERIALS (ME 804/4)

Structures and method of preparation of fibres and fibre reinforced composites. Micromechanics and prediction of elastic constants. Strength of composites. Properties of laminated composites and their constitutive equations. Laminates. Interfacial mechanics and properties. Applications.

ADVANCED TECHNIQUES IN THERMAL FLUIDS ENGINEERING (ME 804/5)

Perturbation methods, transform methods, complex variables, eigen functions and series solution methods. Measurements of flow and temperature fields, optical methods, interpretation of data, design of experimental methods. Numerical method.

COMPUTER AIDED DESIGN OF THERMAL SYSTEMS (ME 804/6)

Simulation of thermal processes, application to casting, extrusion, heat treatment, thermal design of heat exchangers, electronic circuitry. Optimization search method and geometric programming, control strategy, data storage and retrieval. Expert systems.

COMPRESSIBLE FLUID DYNAMICS (ME 804/7)

Fundamental concepts and results for the compressible flow of gases. Topics include: appropriate conservation laws; propagation of disturbances; isentropic flows; normal shock wave relations, oblique shock waves, weak and strong shocks, and shock wave structure; compressible flows in ducts with area changes, friction, or heat addition; heat transfer to high speed flows; basic concepts of pneumatics; unsteady compressible flows, Riemann invariants, and piston and shock tube problems; steady 2D supersonic flow, Prandtl-Meyer function; and self-similar compressible flows. Emphasis on physical understanding of the phenomena and basic analytical techniques.

QUALITY ASSURANCE AND RELIABILITY (ME 804/8)

Product evaluation for marketing customer needs, product development. Designing for quality and reliability. Design Review, Robust Design, Maintainability Analysis, Safety Analysis, Human factor Analysis, Manufacturing and Inspection Analysis, valve engineering supplier relation, Process capability analysis, pre-production trials and runs.

Statistical process control, statistical quality control, evaluation of process control tools, statistical quality control. Quality planning, quality cost, quality control, quality audit; Total quality management. Product reliability, equipment survival, reliability prediction, testing and analysis, failure mode. Effect and critical analysis.

ELECTIVE – III

VISION SYSTEM IN ROBOTICS (ME 805/1)

Current topics in robotics and machine vision with applications to flexible, automated manufacturing; emphasis is on integrated problems and techniques for fine motion control, calibration, acquisition of sensory data, and programming. Cell level topics: architectures and strategies for cell control. Research issues: dexterous manipulation and languages for high-level task specification. Typical projects: robotic debarring, assembly using force feedback and/or vision, part inspection, and cell control. Short assignments provide practice with various equipment. Enrolment limited to 30.

METAL FORMING (ME 805/2)

Fundamentals of plasticity, yield and flow, anisotropy, instability, limit analysis, slip line field theory. Applications to forging, wire and tube drawing, deep drawing, extrusion and rolling. High velocity forming.

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MECHANICAL HANDLING SYSTEMS AND EQUIPMENTS (ME 805/3)

Introduction to various Mechanical Handling Systems and equipment for handling unit load and bulk materials such as, Pulley blocks, Winches, Electric Hoists, EOT Cranes, Belt Conveyor, Bucket Elevator, Screw conveyor and Pneumatic conveyor etc. Kinematics' analysis and design procedures of their component mechanisms. Illustration about their industrial applications. Introduction to programmable and flexible load handling devices.

NONLINEAR CONTROL SYSTEM DESIGN (ME 805/4)

Introduction to applied nonlinear control. Nonlinear stability theory, Lyapunov analysis, Barbalat's lemma. Feedback linearization, internal dynamics. Sliding surfaces. Adaptive nonlinear control. Contraction analysis, differential stability theory. Nonlinear observers. Stable adaptive control using multi-resolution bases. Stability of nonlinear partial differential systems. Asynchronous distributed computation. Emphasis on applications to physical systems (robots, aircraft, spacecraft, underwater vehicles, reaction-diffusion processes, machine vision, internet).

Optimisation Methods in Engineering Design (ME 805/5)

Concept of conventional and optimum design processes and their comparison. Optimum design problem formulation – Introduction of design variables, cost function and constraint function with examples. Graphical optimisation technique.

Concept of gradient vector, Hessian matrix and quadratic forms. Unconstrained and constrained optimum design problems. Optimality conditions for functions of single and several variables. Langrange multipliers, Kuhn-Tucker necessary conditions, Global optimality. Numerical methods for unconstrained optimum design – Algorithms of Steepest Descent Method, Conjugate Gradient Method and Newton's method. Numerical methods for constrained optimum design – Basic concepts and ideas. Constrained Steepest Descent (CSD) method and algorithm. Concepts of evolutionary algorithm based optimisation methods.

Application of optimum design concepts to specific engineering design applications: Design of a helical compression spring for minimum mass, Shape optimization (based on minimum weight design) of a three-bar truss, Design synthesis of a nine-speed gear drive.

COMPUTATIONAL FLUID DYNAMICS (ME 805/6)

Discretisation procedure in Finite-difference and Finite-volume. Navier-strokes, Energy equations, staggered rectilinear grids. Explicit methods: MAC, SMAC. Implicit Methods: SIMPLE and SIMPLER. Matrix methods, conjugate gradient method, Strongly Implicit Procedure. Grid-Generation: Algebraic, Transfinite, Poisson equation methods. Finite-difference Navier-strokes solution on non-orthogonal grids, transformation. Collocated grids. Finite-volume methods on non-orthogonal grids. Turbulence modelling, k-e modelling, near-wall treatment. Reynold stress models. Model problems. Selected topics in compressible flows and Heat Transfer.

FUNDAMENTALS OF ROBOTICS (ME 805/7)

Dynamic analysis, design, and control of robot. Kinematics and dynamics of multi-input, multi-output rigid body systems. Inverse kinematics, inverse dynamics, and computed torque control. Adaptive and learning control. Force feedback, visual serving. Programming, task strategy planning, teleoperation. Elements of biological planning and control. Digital implementation of control algorithms, term projects.

MANUFACTURING AUTOMATION (ME 805/8)

Automation strategies, flow lines, automated assembly systems, transfer systems; Vibratory bowl feeders, non-vibratory feeders. Part orienting, feed track, part placing and part escapement systems; Programmable automation, industrial robotics; Flexible manufacturing systems; Automation equipment.

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VEHICLE DYNAMICS DESIGN **(ME805/9)**

The application of the principles of dynamics, kinematics and control theory to the design and analysis of ground vehicle behaviour. Simplified models of ride, handling, and braking, their role in developing intuition, and their limitations in engineering design. Suspension design fundamentals. Multibody dynamics approaches to vehicle modelling. Performance and safety enhancement through automatic control systems such as anti-lock braking, active suspensions, and stability control.

MAINTENANCE ENGINEERING **(ME 805/10)**

Objectives of maintenance, maintenance strategies (breakdown, preventive, planned, scheduled, diagnostic, designing out, total productive maintenance, reliability centred maintenance) organization for maintenance, maintenance requirements, maintenance planning and work control, maintenance records, frequency of maintenance, cost of maintenance, maintenance effectiveness, spare parts provisioning.

Equipment replacement strategies, overhaul policies.

Failure analysis, failure mode-effect and criticality analysis, fault tree analysis. Reliability and availability requirements condition monitoring methods, tools, equipment, instrumentation. Designing for maintainability. Accidents and disaster management, logistic support, safety, healthy and environmental protection, case studies.

Course details of the Elective Subjects (*Elective – I, II, III*)

ELECTIVE – I

INTRODUCTION TO MECHATRONICS **(ME 705/1)**

Introduces the technologies involved in mechatronics (Intelligent Electro-Mechanical Systems) and the techniques necessary to apply this technology to mechatronic system design.

Electronics (A/D, D/A convertors, op-amps, filters, power devices); software program design, event-driven programming; hardware and DC stepper motors, solenoids, and robust sensing. Lab component of structural assignments. Large and open-ended team project. Limited enrolment.

COMPUTATIONAL NANOTECHNOLOGY **(ME 705/2)**

Current research topics in computational nanotechnology. Overview of atomistic modelling methods for nanoscale materials science and device technology: classical molecular dynamics, Monte Carlo simulations, and quantum mechanical simulations. Nanotube device modelling: chemical and biosensors, electromechanical sensors and actuators, nanotransistor, nanotube polymer composites. Atomistic simulations of nanomechanics of materials: nanocrystalline solids, thin films, patterned nanostructures. Design of novel nanodevices with fullerenes and biomolecules: multi-walled fullerenes and nano peapods for quantum devices, biomolecule-solid surface functionlization. Nano particles and clusters: novel electronic and optical devices.

COMPUTER INTEGRATED MANUFACTURING SYSTEMS **(ME 705/3)**

Software tools for CIMS. Basics of DBMS, DSS, distributed computing and LAN and FAN. Shop floor automatic identification techniques, CAD/CAM. Industrial robotics: Single and mixed product manufacturing, robotized assembly. GT applications. FMS: analysis. Automated material handling.

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ADVANCED SYSTEM DYNAMICS AND CONTROL (ME 705/4)

Analytical and graphical descriptions of state-determined dynamic physical systems; time and frequency domain representations; system characteristics-controllability, observability, stability; linear and nonlinear system responses. Modification of system characteristics using feedback. State observers, Kalman filters. Modeling/performance trade-offs in control system design. Emphasis on application of techniques to physical systems.

FATIGUE, CREEP AND FRACTURE (ME 705/5)

Fatigue: Nature of fatigue, Types of fatigue loading, Simple stress fatigue properties with fixed and varying amplitude; combined stress fatigue properties. Notch sensitivity. Factors influencing fatigue strength, fatigue tests. Utilization of fatigue properties in design.
Creep: Creep stress-time-temperature relations for simple tension and combined stresses. Recovery creep and relaxation, Testing techniques representation of test data.
Fracture: Basic modes of fracture, Introduction to the theories of Linear Elastic Fracture Mechanics. Griffith's theory of brittle fracture, Irwin's theory of fracture in elastic-plastic materials, stress intensity factors. Fracture toughness testing and interpretation of test data. Fracture of composite materials. Damage mechanics and experimental analysis.

WAVE PROPAGATION (ME 705/6)

Theoretical concepts and analysis of wave problems in applied mechanics with examples chosen from elasticity, acoustics, geophysics, hydrodynamics, blood flow, and non-destructive evaluation. Progressive waves, group velocity and dispersion, energy density and transport. Theory of characteristics. Reflection, refraction and transmission of plane waves by an interface. Mode conversion in elastic waves. Rayleigh waves. Waves due to a moving load. Scattering by a two dimensional obstacle. Reciprocity theorems. Parabolic approximation. Waves on the sea surface. Capillary-gravity waves. Wave resistance. Radiation of surface waves. Internal waves in stratified fluids. Waves in random media.

FINITE ELEMENT ANALYSIS IN ENGINEERING (ME 705/7)

Basic principles of continuum mechanics and finite element methods, modern application to solution of practical problem in solid, structural, heat and mass transfer and other field problems. Kinematics of deformation, strain and stress measures, constitutive relations, conservation laws, virtual work and variational principles. Weighted residual method and Galerkin techniques in finite element formulation. Discretization of governing equations using finite element methods. Solution of central problems using existing computer programs.

FUNDAMENTALS AND MODELING IN COMBUSTION (ME 705/8)

Fundamentals and modelling of physical gas dynamics and combustion using analytical and numerical methods. Conservation equations of reacting flows. Chemical thermodynamics and kinetics. Non-equilibrium flow. Detonation and boundary layers. Ignition, flammability, and extinction. Premixed and diffusion flames. Combustion instabilities. Supersonic combustion. Turbulent combustion. Fire, safety, and environmental impact.

SOLAR ENERGY THERMAL PROCESSES (ME 705/9)

Fundamentals of solar radiation Review of fluid mechanics and heat transfer. Flat plate collectors, Focussing collectors, Solar water and air heating systems, solar cooling and dehumidification, solar energy storage, solar electric power, solar distillation of saline water and solar stills, solar cookers, solar pond and its thermal performance.

NC/CNC MACHINE TOOLS (ME 705/10)

Basic Architecture of NC and CNC Machine Tools. Classifications of difference CNC Systems. Data Processing Unit (DPU): Interpolator Hardware and Software, Machine Control Unit (NCU), Sensors and Actuators in CNC Machine Tools – Encoders, Stepper Motor, Machine Drive Unit (MDU), Control Software, Adaptive Control in CNC Machine Tools, Part Programming Fundamentals.

Introduction to the Finite Element Method (ME 70*/*)

Basic concepts of the Finite Element Method (FEM). FEM solution of standard discrete systems: 1-D springs and plane truss. Generalization of the finite element concepts – weighted residual, Galerkin method and variational approaches. FE formulation of steady state field problems (governed by 1-D and 2-D differential equations) such as heat conduction, fluid flow etc. Shape functions for triangular, rectangular elements. Isoparametric elements. Application of FEM to structural mechanics problems: plane stress, plane strain and axisymmetric stress analysis. Natural coordinates, numerical integration. Computer implementation of finite element procedures.

Composite Materials (ME 705/)

Definition of fibre reinforced composite materials with examples, benefits properties and applications. Fabrication processes. Rules of mixtures, Halpin-Tsai equations for effective moduli of a continuous fibre-reinforced lamina.

Stress-strain relationship of a continuous fibre-reinforced lamina: both specially and generally orthotropic type. Theories of failure for continuous fibre-reinforced lamina: maximum stress, maximum strain, Tsai-Hill and Tsai-Wu criteria. Analysis of lamina hygrothermal behaviour. Mechanical testing of composites.

Analysis of composite laminates with classical lamination theory. Extensional, Coupling and Bending stiffness matrices. Stiffness characteristics of selected laminate configurations: symmetric, antisymmetric and quasiisotropic types. Determination of stresses and strains in different plies. Residual stresses in laminae due to hygrothermal effects.

ELECTIVE – II

TURBOMACHINES (ME 804/1)

Introduction to engineering applications involving compressible flow: aircraft propulsion, rocket propulsion, power generation; application of mass, momentum, energy and entropy balance to compressible flows; variable area isentropic flow, normal shock waves, adiabatic flow with friction, flow with heat addition. Operation of flow systems: the propulsion system. Introduction to turbomachinery: pumps, compressors, turbines. Angular momentum analysis of turbomachine performance, centrifugal and axial flow machines, effect of blade geometry, dimension-less performance of turbomachines; hydraulic turbines; steam turbines; wind turbines. Compressible flow turbomachine: the aircraft engine.

CIRCULATING FLUIDIZED BED TECHNOLOGY (ME 804/2)

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AUTOMOBILE ENGINEERING (ME 804/3)

Engine: Valves and cam shafts, cam shaft chain, belt and gear train drives, engine balancing and vibration, combustion chamber design and performance, introduction and exhaust systems, supercharging systems, carburetted fuel systems, diesel fuel injection pump systems, cooling and lubrication system, emission control. Modern multipoint fuel injection (MPFI) engines.

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Automotive Electrical and Electronics Systems: Automotive electrical system, battery, starting system, contact-point ignition system, electronic ignition system. Automotive Power Trains: Automotive clutches, drive lines and universal joints, differential and drive axels.

Automotive Chains: Spring and spring system, automotive steering system, automotive brakes, tires and wheels, air-conditioning system.

COMPOSITE MATERIALS (ME 804/4)

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QUALITY ASSURANCE AND RELIABILITY (ME 804/8)

Product evaluation for marketing customer needs, product development. Designing for quality and reliability. Design Review, Robust Design, Maintainability Analysis, Safety Analysis, Human factor Analysis, Manufacturing and Inspection Analysis, valve engineering supplier relation, Process capability analysis, pre-production trials and runs.

Statistical process control, statistical quality control, evaluation of process control tools, statistical quality control. Quality planning, quality cost, quality control, quality audit; Total quality management. Product reliability, equipment survival, reliability prediction, testing and analysis, failure mode. Effect and critical analysis.

ELECTIVE – III

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METAL FORMING (ME 805/2)

Fundamentals of plasticity, yield and flow, anisotropy, instability, limit analysis, slip line field theory. Applications to forging, wire and tube drawing, deep drawing, extrusion and rolling. High velocity forming.

MECHANICAL HANDLING SYSTEMS AND EQUIPMENTS (ME 805/3)

Introduction to various Mechanical Handling Systems and equipment for handling unit load and bulk materials such as, Pulley blocks, Winches, Electric Hoists, EOT Cranes, Belt Conveyor, Bucket Elevator, Screw conveyor and Pneumatic conveyor etc. Kinematics' analysis and design procedures of their component mechanisms. Illustration about their industrial applications. Introduction to programmable and flexible load handling devices.

NONLINEAR CONTROL SYSTEM DESIGN (ME 805/4)

Introduction to applied nonlinear control. Nonlinear stability theory, Lyapunov analysis, Barbalat's lemma. Feedback linearization, internal dynamics. Sliding surfaces. Adaptive nonlinear control. Contraction analysis, differential stability theory. Nonlinear observers. Stable adaptive control using multi-resolution bases. Stability of nonlinear partial differential systems. Asynchronous distributed computation. Emphasis on applications to physical systems (robots, aircraft, spacecraft, underwater vehicles, reaction-diffusion processes, machine vision, internet).

Optimisation Methods in Engineering Design (ME 805/5)

Concept of conventional and optimum design processes and their comparison. Optimum design problem formulation – Introduction of design variables, cost function and constraint function with examples. Graphical optimisation technique.

Concept of gradient vector, Hessian matrix and quadratic forms. Unconstrained and constrained optimum design problems. Optimality conditions for functions of single and several variables. Langrange multipliers, Kuhn-Tucker necessary conditions, Global optimality. Numerical methods for unconstrained optimum design – Algorithms of Steepest Descent Method, Conjugate Gradient Method and Newton's method. Numerical methods for constrained optimum design – Basic concepts and ideas. Constrained Steepest Descent (CSD) method and algorithm. Concepts of evolutionary algorithm based optimisation methods.

Application of optimum design concepts to specific engineering design applications: Design of a helical compression spring for minimum mass, Shape optimization (based on minimum weight design) of a three-bar truss, Design synthesis of a nine-speed gear drive.

COMPUTATIONAL FLUID DYNAMICS (ME 805/6)

Discretisation procedure in Finite-difference and Finite-volume. Navier-strokes, Energy equations, staggered rectilinear grids. Explicit methods: MAC, SMAC. Implicit Methods: SIMPLE and SIMPLER. Matrix methods, conjugate gradient method, Strongly Implicit Procedure. Grid-Generation: Algebraic, Transfinite, Poisson equation methods. Finite-difference Navier-strokes solution on non-orthogonal grids, transformation. Collocated grids. Finite-volume methods on non-orthogonal grids. Turbulence modelling, k-e modelling, near-wall treatment. Reynold stress models. Model problems. Selected topics in compressible flows and Heat Transfer.

FUNDAMENTALS OF ROBOTICS (ME 805/7)

Dynamic analysis, design, and control of robot. Kinematics and dynamics of multi-input, multi-output rigid body systems. Inverse kinematics, inverse dynamics, and computed torque control. Adaptive and learning control. Force feedback, visual serving. Programming, task strategy planning, teleoperation. Elements of biological planning and control. Digital implementation of control algorithms, term projects.

MANUFACTURING AUTOMATION (ME 805/8)

Automation strategies, flow lines, automated assembly systems, transfer systems; Vibratory bowl feeders, non-vibratory feeders. Part orienting, feed track, part placing and part escapement systems; Programmable automation, industrial robotics; Flexible manufacturing systems; Automation equipment.

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VEHICLE DYNAMICS DESIGN (ME805/9)

The application of the principles of dynamics, kinematics and control theory to the design and analysis of ground vehicle behaviour. Simplified models of ride, handling, and braking, their role in developing intuition, and their limitations in engineering design. Suspension design fundamentals. Multibody dynamics approaches to vehicle modelling. Performance and safety enhancement through automatic control systems such as anti-lock braking, active suspensions, and stability control.

MAINTENANCE ENGINEERING (ME 805/10)

Objectives of maintenance, maintenance strategies (breakdown, preventive, planned, scheduled, diagnostic, designing out, total productive maintenance, reliability centred maintenance) organization for maintenance, maintenance requirements, maintenance planning and work control, maintenance records, frequency of maintenance, cost of maintenance, maintenance effectiveness, spare parts provisioning.

Equipment replacement strategies, overhaul policies.

Failure analysis, failure mode-effect and criticality analysis, fault tree analysis. Reliability and availability requirements condition monitoring methods, tools, equipment, instrumentation. Designing for maintainability. Accidents and disaster management, logistic support, safety, healthy and environmental protection, case studies.

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DEPARTMENT OF MINING ENGINEERING

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DEPARTMENT OF MINING ENGINEERING

APPROVED SYLLABUS for UNDERGRADUATE (B.E.) COURSE

3RD SEMESTER – MINING ENGINEERING

MN 301 INTRODUCTION TO MINING

Semester Examination : Contact Periods : (3L+ 1 T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 70. **Full Marks – 30.**

Mining terminologies

National earth resources – minerals, rocks & ore

Coal – origin, classification, properties, uses & reserve

Prospecting and exploration techniques

Rock drilling – exploratory diamond drilling and production drilling

Explosives, accessories and blasting practices

Introduction to Remote Sensing and GIS.

MN 302 MINE DEVELOPMENT

Semester Examination : Contact Periods : (3L+ 1 T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 70. **Full Marks – 30.**

Means of access to mineral deposits

Conventional and special methods of shaft sinking

Underground mine supports (coal and metal) : Principle, timber support, roof bolting principle, different types of roof bolt, roof stitching, friction props, hydraulic props and modern supports.

Stowing : Mechanical, Hydraulic and Pneumatic

MN 351 INTRODUCTION TO MINING LAB

Full Marks : 50 **Contact Period : (2S)**

LABORATORY EXPERIMENTS BASED ON INTRODUCTION TO MINING (MN301)

MN 352 MINE DEVELOPMENT LAB

Full Marks : 50 **Contact Period : (3S)**

SESSIONAL WORKS BASED ON MINE DEVELOPMENT (MN302)

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4th SEMESTER – MINING ENGINEERING

MN401 Underground Coal Mining

Semester Examination : Contact Periods : (3L+ 1 T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 70. **Full Marks – 30.**

Overview of Indian coal mining conditions
Unit operations in coal mining
In seam and horizon mining systems
Choice of working methods, size of barriers, panels
Bord & Pillar method of mining- development and depillaring operations. with caving and stowing Recent developments
Pillar mining for contiguous seams
Longwall mining- selection of Longwall technology, classification, various layouts. Longwall evoluation-short longwall, miniwall etc.. Conventional and fully mechanised Longwall methods. Design of longwall workings. Strata behaviour and support requirements.
Relevant clauses of Coal Mines Regulations

MN402 Surface Mining

Semester Examination : Contact Periods : (3L+ 1 T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 70. **Full Marks – 30.**

Basic concept of opencast mines.

Surface mine layouts. Methods of opening of deposits.
Design of benches.
Selection and application of drilling, blasting, excavation, loading and transportation equipment
Placer mining, dredging
Recent developments

MN403 Underground Mine Environment

Semester Examination : Contact Periods : (3L+ 1 T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 70. **Full Marks – 30.**

Composition of mine atmosphere
Mine gases – properties, physiological effects & analysis
Mine climate – heat and humidity
Dust – hazard assessment and control
Mine fines & spontaneous heating – causes, prevention & control
Mine explosions – causes, prevention & control
Inundation – causes, prevention & control
Rescue & recovery – rescue equipment & organisation
Illumination – standards & arrangements
Noise control; Occupational health of miners ; Relevant clauses of coal & metalliferrous mine regulations.

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MN404 **Mines Surveying**

Semester Examination : Contact Periods : (3L+ 1 T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 70. **Full Marks – 30.**

Introduction & surveying principles
Linear measurement with chain, tape & EDM
Angular measurements – Compass & Theodolite
Traversing – open & closed
Triangulation and Trilateration
Tacheometric survey
Leveling & contouring
Plane table survey
Development in surveying instruments

MN451 Mines Surveying Practical

(Sessional Subject)
Full Marks – 50. Contact Periods : 4S

Practical work related to the topics covered in Mine Surveying (MN 404)

MN471 Educational Tour

(Sessional Subject)
Full Marks – 50. Contact Periods : 0 0 0

Tour to Underground and Open Cast mines

5th SEMESTER – MINING ENGINEERING

MN 501	**L**	**T**	**S**
Mine Ventilation Engineering	**3**	**1**	**0**

Fundamentals of air flow. Air flow through mine openings

Natural ventilation- principles, calculations

Mechanical ventilation- devices, characteristics, selection. Auxiliary and booster ventilation

Ventilation survey

Ventilation control devices

Ventilation schemes for different mining methods

Ventilation planning

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MN 502 **L T S**
Fundamentals of Rock Mechanics **3 1 0**

Fundamentals of rock mechanics

Physico-mechanical properties of rocks. Elastic, non-elastic, dynamic and time-dependent behaviour.

Laboratory methods of rock testing

Theories of rock failure

Rock mass classification

Methods of stress analysis

In situ stresses and stresses around mine openings

Photo-elasticity and scale model studies

Basics of numerical methods in rock mechanics with applications

MN 503 **L T S**
Advanced Surveying **3 1 0**

Curve Ranging

Fundamentals of field astronomy

Borehole and fault problems

Area and volume calculations

Correlation

Stope Surveying

Control of direction and distance in mines

Map projections

Mine plans and sections

Errors and adjustments

MN 504 **L T S**
Under ground Mining Machinery **3 1 0**

Horizontal transport system through haulages- rope haulage, locomotives, conveyors. Mine cars

Underground coal preparation and ancillary equipment- drill, roof bolter, coal cutting machine, cable, gate end box

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Underground loading machines- scraper, LHD, SDL

Underground continuous coal winning machine- continuous miner, shearer, plough, roadheader

Vertical transport system through winders

Mine de-watering system- pump, pipe layouts and sumps.

Compressed air system in mines

Brief outline of hydraulic and pneumatic conveying

Relevant clauses of rules & regulations

	L	T	S
GE501	**L**	**T**	**S**
Mining Geology	**3**	**1**	**0**

Economic geology – principles, metallic and non-metallic deposits
Structural geology
Ground water
Geology of tunnel site

GE551	**L**	**T**	**S**
Mining Geology Lab	**0**	**0**	**2**

Study of rocks (igneous, sedimentary & metamorphic) in hand specimen
Study of common rocks in thin section

MN 551	**L**	**T**	**S**
Survey Practical	**0**	**0**	**3**

Practical work related to the topics covered in Min 504

MN 552	**L**	**T**	**S**
Under ground Mining Machinery	**0**	**0**	**2**

Laboratory work related to the topics covered in Min 505

MN 553	**L**	**T**	**S**
Ventilation Engineering Lab	**0**	**0**	**2**

Laboratory work related to the topics covered in Min 503

MN 554	**L**	**T**	**S**
Rock Mechanics Lab	**0**	**0**	**2**

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Laboratory work related to subject Min 502.

MN 571	**L**	**T**	**S**
V.T. Evaluation-I	**0**	**0**	**0**

Viva-Voce and report evaluation on Vocational training undergone after Fourth semester.

6th SEMESTER – MINING ENGINEERING

MN 601	**L**	**T**	**S**
Rock Mechanics Applications	**3**	**1**	**0**

Theories of rock fragmentation- rock cutting and blasting

Ground failure and pressure on supports. Design of supports

Stability of wide openings

Mechanics of rock bursts and bumps

Subsidence phenomenon

Stability of slopes

Instrumentation and measurement of in situ stresses and rock strength

MN 602	**L**	**T**	**S**
Optimization Techniques in Mineral Industry	**3**	**1**	**0**

Linear programming- concepts, graphical solutions, Simplex method, primal-dual models, sensitivity analysis, transportation and assignment problems

Network analysis- problems of shortest path, minimal spanning tree, maximal flow, CPM and PERT

Dynamic programming and stagecoach problem.

Discrete and continuous probability distributions, stochastic process and Markov chains

Basic queuing models with constant arrival and service rates

Inventory models

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MN 603	**L**	**T**	**S**
Environmental Science and Engineering	**3**	**1**	**0**

Environment and development. Global Environmental phenomena

Different cycles of environment

Overview of the impact of mining on the environment

Visual impact

Sources and control measures of air, water, and noise pollution in mines.

Ground vibration from blasting- causes, prediction and control. Air blast phenomenon

Tailings disposal

Techniques of land reclamation and waste dump management

Status of environmental legislation in India specific to mineral industry

EIA/EMP, environmental audit, Relief and Rehabilitation

Environmental economics.

MN 604	**L**	**T**	**S**
Underground metal mining	**3**	**1**	**0**

Underground metal mine development- driving, raising, winzing and other development excavations

Borehole mining, leaching

Underground methods- selection, underhand and overhead system, Shrinkage stoping, Sublevel stoping, VCR, Cut & Fill(underhand & overhand), Post and Pillar, Square set stoping. Recent developments

Metal mine planning- scheduling, planning methodology, computer application in planning

Relevant clauses of Metal Mine Regulations

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MN 605	**L T S**
Opencast Mining Machinery	**3 1 0**

Design features of Excavators

Design, construction and maintenance of opencast loading and hauling machines..

Design, construction and maintenance of opencast drilling machines.

Dozers, Reclaimers, Stackers, Spreaders and HAC

Other ancillary opencast machines.

Aerial ropeway

Current trends in mine mechanisation

Relevant clauses of rules and regulations

GE 601	**L T S**
Stratigraphy & Paleontology	**3 1 0**

Principles of stratigraphy and Indian stratigraphy
Outlines of paleontology

GE 651	**L T S**
Stratigraphy & Paleontology Lab	**0 0 2**

Study of contours pattern
Dip problems
Maps – study of homoclinal beds, folds, faults & unconformity

MN 651	**L T S**
Opencast Mining Machinery lab	**0 0 2**

Practical work related to the topics covered in Min 605

MN 652	**L T S**
Environmental Science & Engineering lab	**0 0 2**

Laboratory work related to the topics covered in Min 603

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MN 653	**L T S**
Optimization Techniques Lab	**0 0 3**

Laboratory works related to the topics in Min 602

MN 671	**L T S**
Education Tour - II	**0 0 0**

Educational tour to O/C and U/G mines

MN 672	**L T S**
Comprehensive Viva-Voce & VT Evaluation	**0 0 0**

Viva voce on the subjects dealt till 6^{th} semester
Report evaluation of the training undergone at the end of fifth semester
Viva voce on training undergone at the end of fifth semester

7^{th} SEMESTER – MINING ENGINEERING

MN 701	**L T S**
Mines Act, Regulation and Legislation	**3 1 0**

Provisions of Mines Act (1952), Mines Rules (1955), Coal Mines Regulation (1957), Metalliferous Mines Regulations (1962) and Indian Electricity Rules

Other rules and regulations, Important updated circulars

Safety promotional activities, Classification of accidents Accident statistics, Accident reports

MN 702	**L T S**
Mineral Beneficiation	**3 1 0**

Comminution- crushing, grinding

Sizing- industrial screening

Classification

Gravity concentration- Jigging, tabling

Heavy media separation

Floatation

Electro-static separation

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Magnetic separation

De-watering- thickener

Coal preparation plant, Dry deshaling

Mineral beneficiation plant

New development in beneficiation equipment

MN 703	**L**	**T**	**S**
Principles of Mineral Economics	**3**	**1**	**0**

Mineral resources in India, worldwide distribution of minerals

Future mineral & energy resources

Theory of sampling

Mine valuation, depreciation, present value concept

Mineral taxation and incentive measures

Marketing and Pricing of minerals

National mineral policy

Feasibility study and detailed project report

Tenor, grade, specification

Forms of business organisation

Cost of mining

Strategic, critical and essential minerals

MN 704	**L**	**T**	**S**
Computer Applications in Mining	**3**	**1**	**0**

Discrete event simulation and related statistical concepts

Simulation of longwall mining and openpit transportation systems

Reliability models

Basics of management information systems

Mine ventilation network analysis

Truck despatch systems

Ultimate pit design models

Production scheduling for grade control

Overview of blast simulation packages

Integrated mining software

Expert systems with special reference to mineral industry

GIS with special reference to mineral industry

MN 705	**L**	**T**	**S**
Special Underground Methods	**3**	**1**	**0**

Underground metal mining methods- sublevel caving, block caving. Caving mechanism. Drawing of ore in caving methods

Stope mechanization

Concept of thick seam- problems and remedies

Special methods of mining thick and steep seams

Elective-I MN 706/

MN 706/1	**L**	**T**	**S**
Geostatistics	**3**	**1**	**0**

Review of classical statistical concepts, basics of 3-dimensional mineral inventory development

Regionalised variables, variogram modeling, regularisation, auxiliary functions, linear kriging methodology and applications, variance volume relationship.Geostatistics for quality control

Basics of non-parametric geostatistics and indicator kriging, introduction to GEOEAS software

MN 706/2	**L**	**T**	**S**
Quality Control in Mining	**3**	**1**	**0**

Relevant guidelines regarding ash content in coal

Quality standard and quality management

Quality system- quality system documentation

ISO standards- ISO 9000, ISO 14000, BSI 18000

Quality measurement at various operations in mines

Total Quality Management

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MN 706/3	**L**	**T**	**S**
Reliability and Safety Engineering	**3**	**1**	**0**

Introduction to Reliability, Overview of probability and Statistics

System reliability modeling, maintainability and availability, risk analysis, reliability and risk management

Industrial safety, occupational hazards, human factors and assessment of risk factors

Statistical analysis of accident data, multivariate modeling

MN 751	**L**	**T**	**S**
Mineral Beneficiation Lab	**0**	**0**	**2**

Laboratory work related to Min 702

MN 752	**L**	**T**	**S**
Computer Applications in Mining Lab	**0**	**0**	**3**

Laboratory work related to Min 705

MN 753	**L**	**T**	**S**
Elective I Lab	**0**	**0**	**2**

Laboratory work related to Min 704

MN 553	**L**	**T**	**S**
Project Preliminaries	**0**	**0**	**2**

Preliminary work on a subject related to mining industry, which will be taken up as project topics in eighth semester.

MN 754	**L**	**T**	**S**
Seminar and Group discussion	**0**	**0**	**2**

Seminar presentation on selected topics

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MN 571 **L T S**
V.T. Evaluation **0 0 0**

Evaluation of Report and Viva-Voce on Vocational training undergone after the end of sixth semester.

8th SEMESTER – MINING ENGINEERING

MN 801 **L T S**
Ergonomics and Geoinformatics **3 1 0**

Physical work load capacity, Workload classification, Ramanathan & Christensen theory, Aerobic capacity and its effect on workers, Energy expenditure calculation, human factors, Environmental load and its assessment, Hand arm and whole body vibration and its measurement, Heart rate measurement, Assessment of fatigueness, Determination of rest pause period for different mining activities.

Fundamentals of remote sensing- stages in remote sensing, electromagnetic radiation and electromagnetic spectrum, effects of atmosphere, scattering

Remote sensing platforms and sensors

Methods of image interpretation

Fundamentals of digital image processing

GIS- introduction and trends. Hardware and software requirements. Data structure. Topology creation. Linkage between spatial and non-spatial data. Errors

Projection systems in GIS

Query analysis(spatial and non-spatial)

MN 802 **L T S**
Principles of Mine Management **3 1 0**

Modern management theories

Production management in mines

Financial management in mines

Materials management in mines

Behavioural sciences for management

Mine project management

Marketing management for mines

Management information system

MN 803	**L**	**T**	**S**
Mine Planning and Design	**3**	**1**	**0**

Different phases of mine planning

Interpretation of exploratory data

Feasibility analysis

Decision making models

Application of geostatistics in mineral resource estimation

Recent development

Computer application in mine planning.

Elective –II MN804/

MN 804/1	**L**	**T**	**S**
Tunnel Engineering	**3**	**1**	**0**

Types of underground excavation: tunnels, shaft, cavern, etc.

Parameters influencing location of a tunnel and its design, planning and site investigation for tunneling, methods of tunneling; selection of method of excavation.

Tunneling in soft ground

Tunneling in rock by drilling and blasting- method of excavation and design of blasting round.

Tunneling in rock by road heading machines: cutting principles, method of excavation, selection, performance, limitation and problems; TBM application in coal mines.

Excavation of large tunnels, special storage and underground space.

Cut and cover tunnels

Muck disposal

Hazards in tunneling

Supports in tunnels.

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MN 804/2	**L T S**
Mine Automation & Communication System	**3 1 0**

Introduction to circuits and devices.

OP-AMP, digital circuits and its application, principles of communication, power electronics, network and satellite communication, SCADA and Hierarchical Automation

Scope of automation in underground and opencast mines

MN 804/3	**L T S**
Bulk Solids Handling	**3 1 0**

General idea of bulk solids handling

Coal handling plant

Belt conveyor design

Feeders, vibrating screens, crushers and breakers, lifting

Stacking & reclaiming equipment, loading system

Ore handling system in metal mines

Pneumatic and hydraulic transportation of bulk materials- slurry pumps and pipelines

New development in bulk material handling equipment & process

MN 851	**L T S**
Mine Planning & Design Practical	**0 0 3**

Laboratory work based on the topics covered in Min 806
Hands on practice on metal mining & coal mining software.

MN 852/	**L T S**
Elective II Sessional	**0 0 3**

Laboratory work related to Min 802

MN 853	**L T S**
Seminar and Group Discussion, Group Task	**0 0 3**

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Seminar presentation and group discussion on recent topics related to mineral industry

MN 854	**L**	**T**	**S**
Project & Thesis	**0**	**0**	**6**

Project work on any selected topics relevant to mining industry.

MN 871	**L**	**T**	**S**
Comprehensive Viva-Voce	**0**	**0**	**0**

Viva-voce on all the subject dealt till eighth semester.

Elective III	**L**	**T**	**S**
	3	**1**	**0**

Non Departmental

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DEPARTMENT OF METALLURGY AND MATERIALS ENGINEERING

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DEPARTMENT OF METALLURGY AND MATERIALS ENGINEERING

APPROVED SYLLABUS for UNDERGRADUATE (B.E.) COURSE

THIRD SEMESTER

MT 301 INTRODUCTION TO MATERIALS

Semester Examination : Contact Periods : (3L+ 1 T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 70. **Full Marks – 30.**

Metallic and non-metallic Engineering materials in common use, application and selection criteria of materials. *Atomic structure & bonding* -atomic size/structure, effect of bonding on material properties. *Structure of solids*: - Crystalline structure in materials; crystal system/lattice/structure, crystallographic indexing of planes & directions, significance of microstructure; defects in crystals, amorphous structure.

Phase diagrams: Origin, construction, interpretation and application of binary phase diagrams with reference to a few important metallic and ceramic systems. *Properties of materials*:- physical, mechanical, chemical, electrical, semi/super conducting, magnetic, optical, thermal properties of solids, *Methods of manufacture* - basic outline of manufacturing methods of Rolling, Forging, Extrusion, Drawing. Etc; *joining methods*- Welding, brazing and soldering.

Engineering materials: Structure, properties, processing, fabrication and application of metals/alloys, ceramics, polymers, semiconductors, and composites.

MT 302 METALLURGICAL THERMODYNAMICS AND KINETICS

Semester Examination : Contact Periods : (3L+ 1 T)
Time-3 hrs. **Internal Assessment :**
Full Marks – 70. **Full Marks – 30.**

Importance of Thermodynamics, First Law- Equations of state, extensive and intensive properties homogeneous and heterogeneous systems.Internal energy, heat capacity, enthalpy, isothermal, and adiabatic processes. The Second law of thermodynamics, entropy, criteria of equilibrium, Maxwell's relations, Gibbs-Helmholtz equation etc.; Third law of Thermodynamics, temperature dependence of entropy.

Fugacity, activity, equilibrium constant, homogeneous and heterogeneous equilibria. Ellingham-Richardson diagrams, phase stability diagrams.

Solutions, partial molal quantities, ideal and non-ideal solutions, Henry's law, Gibbs - Duhem equation, regular solution, Change of standard state. Phase relations and Phase Rule-its applications. Free energy composition diagrams for binary alloy systems, determination of liquidus, solidus and solvus lines. Effect of pressure on phase transformation and phase equilibria. Numerical problems illustrating thermodynamic principles applied in metallurgy.

Introduction to metallurgical kinetics, heterogeneous reaction kinetics-gas-solid, solid-liquid, liquid-liquid and solid-solid systems. Concepts of Empirical and semi-empirical kinetics, shrinking Core model, Johnson- Mehl equation.

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MT 351 INTRODUCTION TO MATERIALS LAB

Full Marks : 50 **Contact Period : (3S)**

LABORATORY EXPERIMENTS BASED ON INTRODUCTION TO MATERIALS MT 301

FOURTH SEMESTER

MT401 Introduction to Physical Metallurgy

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Atomic arrangements, Crystallinity, Bonding and their effect on material properties; Crystallography: Lattice, Indexing of Plains and Directions; Defects in Crystals: dimensions, origin and their effect on properties;

Solid solutions: Thermodynamics and theories of alloying; free energy-composition diagrams; Intermetallic compounds and intermediate phases; Basic concepts of ordered solid solutions and some common types of ordering in alloys;

Diffusion: Fick's laws and their solutions and applications; Atomic mechanism of different kinds of diffusion; Kirkendall effect, uphill diffusion.

Phase diagrams: origin, construction, interpretation; equilibrium phase diagram containing eutectic, eutectoid, peritectic etc; Introduction to ternary equilibrium diagram; Description of some important equilibrium diagrams, viz., Fe-C, Cu-Zn, Cu-Sn, Cu-Al, Ag-Pt, Pb- Sn *etc.*

Significance of structure-properties-processing relationship of engineering materials.

Optical microscopy: principles of different techniques, specimen preparation. Principles of various techniques used for measurement, recordings and control of temperatures. Introduction of thermal analysis

MT402 Deformation Behaviour of Materials

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Important ores and minerals and their occurrence in India; importance of mineral dressing, Various Comminution processes – theories involved, brief description and applications, various Concentration techniques and their applications, mineral dressing circuits and flowsheets.

Refractories: types, classification , properties and testing; selection and applications.

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Unit Processes in pyrometallurgy: calcination, roasting, agglomeration, reduction smelting, matte smelting, flash smelting, converting, distillation, refining etc-suitable examples; Unit processes in hydrometallurgy: leaching, purification of leach liquor, solvent extraction and ion exchange process, techniques of metal recovery from aqueous phase – suitable aplications. Unit processes in Electrometallurgy: Faraday's laws of electrolysis, concept of overvoltage, limiting current

density, Electro-winning and Electro-refining with reference to Cu, Zn, Al etc. Flowsheets and numerical calculations, including material balance and heat balance.

Elements of fluid flow, Newtonian and non-Newtonian fluids, equations of fluid flow. Principles of Heat and Mass Transfer.

MT403 Principles of Extractive Metallurgy

Semester Examination : Contact Periods : (3L+ 1 T)

Time-3 hrs. **Internal Assessment :**

Full Marks – 70. **Full Marks – 30.**

Concept of stress and strain: stress-strain relationships, stress and strain tensor, principal stress and strain, mean stress, stress deviator, maximum shear, equilibrium of stresses, Mohr's circle, equation of compatibility; *Elastic behavior of materials:* Constitutive equations in elasticity, strain energy, elastic stiffness and compliance, effect of crystal structure on elastic constants; *Plastic behavior of materials:* Classification of stress-strain curves, yield criteria, Elements of dislocation theory, movement of dislocation, elastic properties of dislocation, dislocation reactions in different crystal structure, origin and multiplication of dislocations; *Plastic deformation in single crystal and polycrystalline materials:* Critical resolved shear stress, deformation by slip and twinning, deformation band and kink band, strain hardening of single crystal, stress-strain curves of fcc, bcc and hcp materials, role of grain boundaries in deformation, yield point phenomenon, strain ageing, Bauschinger effect; *Strengthening mechanism in materials:* Strain hardening, solid solution strengthening, grain-boundary strengthening, precipitation strengthening, dispersion strengthening and fiber strengthening; Introduction to *deformation behavior of materials at low and elevated temperatures.*

MT451 Introduction to Physical Metallurgy Lab

(Sessional Subject)

Full Marks – 100. **Contact Periods : 4S**

Experiments based on the syllabus of "Introduction to Physical Metallurgy" (MT401)

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FIFTH SEMESTER

MT 501- Phase Transformation

Introduction and classification of phase transformations; thermodynamics of phase change;

Principles of solidification, evaluation of microstructure in pure metals and alloys; Concepts of thermal and constitutional super cooling; Nucleation and growth mechanisms of liquid to solid and solid to solid transformations, Homogeneous and Heterogeneous nucleation; Recrystallization phenomena;

Construction and interpretation of TTT and CCT diagrams; Formation and decomposition of austenite in steels; Characteristics, mechanism and kinetics of pearlitic, bainitic and martensitic transformations.

Characteristics, mechanism and kinetics: Age hardening, Spinoidal decomposition, Massive transformation, Order-disorder transformation;

MT 502 Ironmaking **3-1-0**

Introduction. Raw materials used and their availability in India, required properties, characterization of raw materials, Blast furnace ironmaking – overview and supporting units- Coke ovens,Stoves, gas cleaning systems; design features of blast furnace, washing of iron ore and coal, agglomeration techniques – Process control and current innovations; Reduction mechanism and equilibria with Carbon-Oxygen system, Slag formation, slag chemistry, and characteristics, Reserve Zones, Cohesive Zone and its importance; Injection techniques, modern developments to minimize coke rate and emissions; B.F. anomalies and their prevention, treatment of slag and outgoing gas. Automation and instrumentation. Treatment of hot metal outside blast furnace.

Alternate routes of Ironmaking – Direct reduced Iron; Gas-based and Coal-based DRI; Hot briquetted iron (HBI), problems and prospects of DRI in India.

MT 503- X-ray & Crystallography ***3-1-0***

Introduction to x-ray and electron beam analysis of materials. Production of x-rays, continuous and characteristic spectrum, absorption, filter, detection of x-rays.Diffraction of x-rays: Bragg law, directions and intensities of diffracted beams. Experimental methods in x-ray analysis; Laue methods, powder methods, rotating-crystal methods, Debye Scherrer camera, counters, collimators, diffractometer and spectrometer measurements.

Applications: Orientation of single crystals, crystal structure of polycrystalline materials, precise lattice parameter measurements, phase diagram, order-disorder transformation, detection of phases, chemical analysis, residual stress, texture. Reciprocal lattice and its application in x-rays.

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MT 504- DATA PROCESSING & COMPUTER APPLICATIONS

Introduction to the Digital Computer; *Review of Basic of Programming:* Variables, Assignment; Expressions; Input/Output; Conditionals and Branching; lteration; Functions; Recursino; Arrays; Strings; Pointers; Structures; File Input/Output; Data-Procedure Encapsulation; Dynamic allocation; Linked structures; Introduction to Data Structure; Introduction to soft computing. Numerical solutions of differential equations; Techniques of optimization;

Examples related to Metallurgical and Materials Engineering.

(A programming language like C/C++ may be used as a basis language).

SIXTH SEMESTER

MT -601 Steelmaking and Ferro-alloy Technology 3-1-0

Historical perspective and current scenario; Refining principles applied in Steelmaking. Basic Oxygen Converters (BOF)-principles and kinetics; ;brief overview of various techniques of Top-blown, Bottom-blown and Combined-blown BOF; lance design, slag characteristics; slag splashing technique.

Arc furnace steelmaking – elements of production of alloy steels; Induction furnace steelmaking; use of DRI in steelmaking; principles involved in Secondary steelmaking – De-oxidation; desulphurization, vacuum techniques, remelting refining; Injection Metallurgy; inclusion removal and modification. Ingot casting and Continuous casting; defects in ingots and billets and remedies; Recent technical developments applications. Energy and Environmental aspects, concept of zero CO_2 emission.

Principles of Ferro-alloy production – Application of Submerged Arc furnace; brief discussion on production of Ferromanganese, Ferrosilicon, Ferrochrome, Charge Chrome etc, application of Thermit reduction process , preparation of Specialty ferro-alloys. Applications of Ferro-alloys.

MT 602. Materials characterization

Overview of chemical bonding, fundamentals of crystallography, reciprocal lattice and structures in metals. Determination of grain size strain from X-ray diffraction patterns. Fundamentals of electron microscopy, electron beam specimen interactions. Application of transmission electron and scanning electron microscopy. Electron probe micro analyser; Principles and application of Auger electron spectroscopy, Scanning tunnelling microscopy and Atomic force microscopy.

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MT 603- Non-ferrous Metallurgy **3-1-0**

Basic steps in Extraction of important non-ferrous metals with flowsheet ; Roasting – Kellogg diagram, techniques of roasting; Fundamental steps for extraction of Cu, Ni, Zn, Al, Mg, Ti and nuclear metals; Principle of selection of extraction steps from specific types of ores; Waste treatment, waste management and Environmental aspects. Numerical problems related to extraction and refining, including material balance.

Important non-ferrous alloys ; Grades and applications; Elements of Heat treatment of these alloys and their applications.

MT- 604 Material Properties Evaluation

Introduction to the mechanical behavior of solids, Material properties and their classifications, Importance of materials property evaluation. Hardness, elastic, anelastic, and plastic properties of materials. The relations between stress, strain, strain rate, and temperature for plastically deformable solids. Introduction to compression, shear and impact properties of materials. Influence of composition, heat-treatment, microstructure, temperature, environmental effects on mechanical properties emphasizing the relationships between microstructure and mechanical properties.

Analyses of failure mechanisms such as fatigue, fracture and creep. Their controlling mechanisms, Prerequisites. Principles and techniques of non-destructive evaluation methods - interpretation of test results.

MT-605- Heat treatment technology 3-1-0

Review of physical metallurgy principles underlying heat treatment of steels.

T-T-T and C-C-T diagrams, hardenability of steels, role of alloying elements, effect of pre-treated conditions. Quenching media and their characteristics, quenching and transformation stresses, hardening and tempering of steels, surface hardening of steels: chemical and non-chemical processes. Thermal and thermo-mechanical processes: austempering, martempering, patenting, ausforming etc. Heat treatment of plain-C, tool and special alloy steels. Heat treatment of cast iron samples. Heat treatment of important non-ferrous alloys: Al-base, Ti-base, Mg-base. Heat treatment defects and their rectifications; furnace atmospheres; Engineering and economic consideration in heat treatment: calculations on heating and cooling and charges, equipment of heat treatment shops and their selection, mechanization, automation, design and layout, pollution etc.

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MT 606-Metal Casting Technology **3-1-0**

Casting as a manufacturing method; patternmaking- design, selection of pattern materials; Methoding;selection of moulding technique, mould-making materials - sand-based aggregates, other materials for moulding, Sand Testing, different modern moulding and core-making techniques; Melting –furnaces, melt treatment for ferrous and non-ferrous melts; Special Casting methods- Die casting, Shell moulding, EPC, Precision casting methods; Outline of Heat-treatment of selected alloy castings- important grades of alloy cast irons,Austempering for Ductile Iron; Common grades of cast products; Rheo-casting and Thixocasting; Entrainment of films in molten metal, Casting defects, remedies and Quality Assurance.

SEVENTH SEMESTER

MT 701-COMPOSITES AND CERAMIC MATERIALS

Composite Materials: Introduction and Classification; Strengthening mechanisms, Mechanics of composite materials; *Composite Properties*: Elastic Properties, Strengths; Design of composites; In-situ and ex-situ composites; *Reinforcements:* Fibers, Strengths of Fibers; *Composite Interfaces:* Bonding Mechanisms, Bond Strength, Interfacial Toughness; *Polymer Matrix Composites*: Polymer Matrices, Processing Techniques, Glass Reinforced Plastics, Carbon Fiber Composites; *Metal Matrix Composites*: Metal Matrices, Processing Techniques, Interfacial Controls, Discontinuously Reinforced Composites, Fiber Composites; *Ceramic Matrix Composites*: Ceramic Matrices, Processing Techniques, Alumina Matrix Composites, Glass Matrix Composites;
Ceramic Materials: Introduction; Crystal Structure and defects; Structure of glasses; Phase diagrams and phase transformation; Ceramic Raw Materials, *Colloidal Properties*:-Particle size and shape, Surface properties, Flocculation and Deflocculation, Rheology, Drain Casting & Solid Casting, Tape Casting, *Forming Processes*: Binders, Packing, Formation, Mechanics, Extrusion, Pressing, Injection Molding, Drying; *Applications*.

MT 702-MATERIALS PROCESSING

Fundamental of metal working: Classification of forming processes, mechanics of metal working, temperature in metal working – hot working vs. cold working, strain rate effects, sliding and sticking friction, lubrication, residual stress; *Forging:* General aspects, closed-die and open-die forging, different types of forging equipment, forging in plane strain, forging loads, forging defects; *Rolling:* Terminology of rolled products, different types of rolling mills; deformation zone, neutral point, angle of bite, draft in rolling; forward slip and backward slip, derivation of rolling load, friction hill, roll flattening, rolling variables, problem and defects in rolled products; *Extrusion:* Direct and indirect extrusion, hydrostatic extrusion, extrusion equipment, derivation of extrusion pressure, deformation, lubrication and defects in extrusion; *Drawing:* Process and equipments, hydrodynamic lubrication, maximum possible reduction in a pass under ideal condition, draw stress with friction and back tension, common defects. Production of tubes including seamless tubes by

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extrusion and rolling; *Sheet metal forming:* Different forming methods, forming limit criteria, defects in formed parts; *Automation and Recent Advances in Metal Working Technology.*

MT – 703 JOINING OF MATERIALS

Basic Welding Processes, their principles and applications – Gas Welding, Arc Welding, Thermit Welding, Resistance Welding, Spot Welding, Pressure Welding etc.

Advance Material Joining Techniques – TIG, MIG, Submerged Arc Welding, Electro- slag Welding, Plasma Arc Welding, Electron Beam Welding, LASER Beam Welding, Ultrasonic Welding, Explosive Welding, Atomic Hydrogen Welding, Under Water Welding, Diffusion Bonding, Friction Stir Welding etc.

Principles of Brazing & Soldering and Joining of Dissimilar Materials.

Selection of Joining Process, Classification of Electrodes & Weld Joints, Welding Codes.

Weldability of different Materials and their Metallurgical and Mechanical aspects.

Physics of Welding – Welding Arc and their type, structure, mechanism, stability & characteristics. Mechanism of Arc Blow, its effect and remedies. Types of metal transfer and forces affecting it.

Defects, Residual Stresses and Distortion in Welded Joints and their remedies.

Welding Design, Inspection & Testing of Joint. Costing of Joints.

MT 704- Degradation of Materials and their prevention 3-1-0

Introduction, technical and economic aspect of the study of corrosion ; review of the electrochemical principles of corrosion cell; exchange current density ; electrode potential and standard cells, EMF series and galvanic series and their applications; Polarization: types, factors involved, effect on corrosion rate; application of Faraday's laws in corrosion;

Mixed Potential theory; Tafel equation , construction and interpretation of Polarization diagrams.

Different forms of corrosion-uniform attack, galvanic, crevice, pitting, intergranular, selective leaching, erosion, stress corrosion cracking, hydrogen effect, corrosion fatigue, liquid metal embrittlement etc -their characteristic features, causes and remedial measures; Corrosion testing methods and interpretation of results.

Principles of corrosion prevention- material selection and design considerations, control of environment - inhibitors, cathodic and anodic protection, surface protection techniques: coatings etc.

Oxidation - Oxide films, Pilling-Bedworth ratio, and their effects on kinetics, oxide defect structures, rate laws, types of oxidation, materials for use at elevated temperatures.

Principles of corrosion prevention-material selection and design aspects; , control of environment including inhibitors, cathodic and anodic protection, coatings and other surface protection techniques of metals and alloys.

Degradation by Wear of materials, characteristics, wear testing ; wear-resistant materials.

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EIGHTH SEMESTER

MT 801- Powder Metallurgy

Development and scope of powder metallurgy; Different metal powder production methods viz., milling, atomization, reduction, electrolysis, carbonyl processes;
Characterisation of metal powders-chemical composition, structure, shape, size and their determination; powder flow, apparent density, tap density, compressibility and porosity measurements; treatment of metal powders.
Behaviour of metal powders during compaction and different compaction techniques like dicompaction, isostatic pressing, powder rolling, powder extrusion etc. types of presses, tooling and die design.
Mechanism of sintering of metal powders, solid state and liquid phase sintering, evaluation of sintered product.
Production and uses of powder metallurgy products like filters, contact materials, bearing, structural parts, dispersion strengthened materials.

MT 802- DESIGN AND SELECTION OF MATERIALS

Relationship between *processing – structure – properties* of various engineering materials; Design process; Materials specifications; Materials selection criteria; Shape and process; Economic and performance criteria; Multiple constraints; Methodology for selecting materials and processes in engineering design - *through case studies*.

ELECTIVE SUBJECTS

ELECTIVE-I

MT 705/1 Nanostructured and functionally graded materials

Introduction to Nanoscience and Nanotechnology. Underlying physical principles of nanotechnology: *Nanostructured Materials,F*undamental physicochemical principles underlying the size dependence of the properties of nanostructured matter. Quantum confinement, single electron charging, Synthesis of nanostructured materials. Top down and bottom up approaches to building nanostructured materials. Properties of nanomaterials. Overview of self-assembly. The basic tools of nanotechnology, scanning probe microscopy and near-field optics; electron and ion-based microscopy and manipulation; Introduction to functionally graded materials, classification of functionally graded materials, properties and preparation techniques. Areas of application.

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MT 705/2-SURFACE ENGINEERING

Introduction to surface-controlled engineering properties; Surface initiated engineering failures - nature and causes; Surface degradation; Importance and necessity of surface engineering; Classification and scope of surface engineering;

Surface protection and modification techniques: classification, principles, methods, and technology. *Conventional surface engineering methods* for ferrous and non-ferrous metals/alloys, tailoring of surfaces of advanced materials; Advantages and limitations of conventional processes.

Surface modification by directed energy beams: ion, electron and laser beams - novelty, process, economics and energy considerations; post-irradiation characterizations (composition & microstructure) and testing/evaluation of surface properties; structure-property correlation.

Recent trends in surface engineering: physical/chemical vapours deposition, plasma spray coating;

ELECTIVE-II

ELECTIVE- III

MT 803/2-ELECTRONIC AND MAGNETIC MATERIALS

Fundamentals of electrons in solids: Properties of a continuum, Atoms in materials, Conduction electrons (Classical & Quantum), Bound electrons; *Materials properties:* Electronic properties of metals, Electronic properties of semiconductors, Electrical properties, Thermal properties, Optical properties, Magnetic properties; *Sensors and actuators:* Technological applications of electronic materials: Microelectronics, Optoelectronics, Superconductivity, Magnetic recording technology.

Electromagnetism - magnetic phenomena on the macroscopic scale: *Introduction:* Magnetic field H and magnetic induction B, Magnetic moment m and magnetization M, Magnetic measurements,Classification different types of magnetic materials, Magnetic properties of materials; Magnetism in materials - microscopic scale : Domains, Domain walls, Domain processes, Magnetic order at the atomic scale, Magnetic moments of electrons, Quantum description of magnetism; Applications of magnetic materials: Soft magnetic materials, Hard magnetic materials, Magnetic evaluation of materials.

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MT 803/2- Heat treatment technology (Elective II for non-department) 3-1-0

Review of physical metallurgy principles underlying heat treatment of steels. T-T-T and C-C-T diagrams, hardenability of steels, effect of alloying elements. Quenching media and their characteristics. Surface hardening of steels: chemical and non-chemical processes.Thermal and thermo-mechanical processes: austempering, martempering, patenting, ausforming etc. Heat treatment of plain-C, tool and special alloy steels with reference to products. Heat treatment of cast irons with reference to products. Heat treatment of important non-ferrous alloys: Al-base, Ti-base, Mg-base. Heat treatment defects and their rectifications; furnace atmospheres; Engineering and economic consideration in heat treatment: calculations on heating and cooling and charges, equipment of heat treatment shops and their selection, mechanization, automation, design and layout, pollution etc.

ELECTIVE-IV

MT 804/1- FRACTURE MECHANICS AND FAILURE ANALYSIS

Introduction; *Continuum Mechanics*: stress, strain; *Linear Elasticity:* beam theory, constitutive laws; *Linear Elastic Fracture Mechanics:* K_I singularity, plasticity considerations, K_{Ic}, CTOD, resistance curves, plane-stress analyses; *Interfacial Fracture Mechanics*: theory, crack-path considerations; subcritical crack growth; *Plasticity*: yield criteria, deformation and flow theories, constitutive laws, Prandtl-Reuss equations, limit analysis; *Nonlinear Elastic Fracture Mechanics:* HRR singularity, J_{Ic}, J_R(□*a*) resistance curves, T_R, CTOA, non-stationary crack-growth analysis; *Environmentally-Assisted Fracture*: stress corrosion, hydrogen embrittlement, corrosion fatigue, *Cyclic Fatigue Failure*: mechanistic aspects, crack propagation, damage-tolerant analysis, variable-amplitude loading, small cracks, crack closure, stress-strain/life analysis, ceramics, intermetallics; *Physical Basis of Toughness*: intrinsic toughening – metals, extrinsic toughening - ceramics, composites, fracture statistics.

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DEPARTMENT OF STUDENT ACTIVITIES

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DEPARTMENT OF STUDENT ACTIVITIES

APPROVED SYLLABUS for UNDERGRADUATE (B.E. & B.ARCH.) COURSE

1st & 2nd semester B.E. and B.Arch. Courses

SA 191 : NCC / Physical Training-I

FM : 50 **(0L + 0T + 2S)**

(for all the BE 1st Semester Students)

(Marks obtained more than the Pass Marks will be added to the Total in 1st Semester)

Objective : To develop Physical fitness, Neuro-muscular co-ordination, Leadership, Fellow filling, Discipline.

Physical Training:

1. Assembly and Roll Call:

Students fall in a line and then attendance is taken.

2. Introductory or Warming-up:

A certain amount of warming-up is essential before indulging in any vigorous activity to avoid muscle pull or catch which are to be started in a slower rhythm and finished with a faster rhythm.
e.g. Walking – jogging – fast running –sprinting –feet astride – jumping jack – running on the spot-arm swinging (forward, upward, downward, backward, sideward & circular movement), trunk twisting, trunk bending exercises.

3. Developmental Part:

This is the most important part in a lesson because of their high physiological values. They develop and maintain body control, body suppleness, good posture and graceful carriage of the body.

This part consist of –
a) Calisthenics, b) Yoga, c) Marching, d) Dumb-bell, e) Wand drill etc.

Major game:
a) Football, Volleyball (For boys)
b) Badminton, Volleyball / Kho-kho (For girls)

4. Recreational part:

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These consist of a variety of minor games, lead-up games, story play etc. No lesson is complete without re-creative activities because they not only develop the natural skills but also provide fun, pleasure and enjoyment to the participants.

5. Assembly and Dismissal:

After the re-creative activities the students will be made to assemble and fall in a line. On dismissal they have to shout once 'JAI HIND' and disperse.

Or, ***NCC:***

Code of Ethics / Conduct: NCC cadets

1. Be truthful, upright and obedient
2. Be humane, cultured and compassionate.
3. Be respectful to your instructors, parents and fellow cadets.
4. Be punctual and well disciplined at all times.
5. Be open and transparent in personal conduct.
6. Be mentally and physically robust.
7. Always protect the weak.
8. Be loyal and faithful to the organization you serve.
9. Spread the message of national integration
10. Espouse social causes.

Annual Training Programme

a) Attention, stand ease, turning including at the halt.
b) Sizing, forming & numbering open and closed order, march and Dressing.
c) Dismissing and Fall in out.
d) Shoulder from the order vice versa.
e) Saluting at the halt, getting parade, dismounting falling out.
f) Saluting at the march.
g) Changing step.
h) Marching in sqd. & halt.
i) Turning at the marching & wheeling.
j) Marching time forward & halt.
k) Discipline & duty, NCC Org. & NCC Song, Nation Integration & its importance, Duty of a good citizen etc.
l) The principles of First Aid, Aid during natural calamities, Water supply & protection.
m) Indian History & culture.

SA 291 : NCC / Physical Training-II

FM : 50 **(0L + 0T + 2S)**

(for all the BE 2nd Semester Students)

(Marks obtained more than the Pass Marks will be added to the Total in 2nd Semester)

Same as "SA 191: NCC/Physical Training - I "

SA 191 A : NCC / Physical Training-I

FM : 50 **(0L + 0T + 2S)**

(for all the BArch, 1st Semester Students)

(Marks obtained more than the Pass Marks will be added to the Total in 2nd Semester)

Same as "SA 191: NCC/Physical Training - I "

SA 291 A : NCC / Physical Training-I

FM : 50 **(0L + 0T + 2S)**

(for all the BArch 2nd Semester Students)

(Marks obtained more than the Pass Marks will be added to the Total in 2nd Semester)

Same as "SA 191: NCC/Physical Training - I "

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DEPARTMENT OF WORKSHOP

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DEPARTMENT OF WORKSHOP

APPROVED SYLLABUS for UNDERGRADUATE (B.E. & B.ARCH.) COURSE

WS 1251 WORKSHOP PRACTICE (for all Engg. Branches)

Full Marks – 50 Contact Periods : (3S)

CARPENTRY SHOP : Specification of wood and wood products, Introduction to Tools and Equipment, Practice Jobs and different wood-joineries and joints.

FITTING SHOP : Introduction to different tools, equipment and measuring devices, Sawing, Filing and Drilling.

SMITHY SHOP, FORGING SHOP and WELDING SHOP : Different equipment and tools used, different simple jobs.

ELECTRIC SHOP : Different types of Electric wires and fittings. Simple house wiring and electric connections.

WS 151A WORKSHOP PRACTICE (for Architecture only)

Full Marks – 50 Contact Periods : (3S)

CARPENTRY SHOP : Specification of wood and wood products, Introduction to Tools and Equipment, Practice Jobs and different wood-joineries and joints.

FITTING SHOP : Introduction to different tools, equipment and measuring devices, Sawing, Filing and Drilling.

MASONRY PRACTICE : Practice of construction of Brick Masonry Wall of English and Flemish Bond, Shallow Foundation, Arch construction, R.C.C. slab and beam casting

ELECTRIC SHOP : Different types of Electric wires and fittings. Simple house wiring and electric connections.

WS – 351 MACHINE SHOP PRACTICE - I (for ME Branch)

Full Marks : 50 Contact Period : (3S)

Study of Lathe Machine and practice of different types of operation like turning, taper turning, knurling, groove cutting.

Study of shaping milling and drilling machines and practice of different types of operation like preparation of case block by shaping machine, preparation of V block by milling machine, preparation of keyway by milling machine, preparation of hole by drilling machine.

WS – 451 MACHINE SHOP PRACTICE - II (for ME Branch)

Full Marks : 50 Contact Period : (3S)

Preparation of gear blank by milling machine, making spur gear and helical gear on cast iron blank by milling machine.

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