

B.E. / B.Arch. V & VI Semester

Prospectus No. 131741

संत गाडगे बाबा अमरावती विद्यापीठ  
SANT GADGE BABA AMRAVATI UNIVERSITY

(Faculty of Engineering & Technology)

**PROSPECTUS**

Prescribed for  
Four / Five Year Degree Course  
Bachelor of Engineering / Bachelor of Architecture

**BRANCHES**

- 1) Civil Engineering
- 2) Mechanical Engineering
- 3) Electrical Engineering (Electronics & Power)
- 4) Electrical and Electronics Engineering
- 5) Electrical Engineering (Electrical & Power)
- 6) Electrical Engineering
- 7) Information technology
- 8) Architecture
- 9) Instrumentation Engineering
- 10) Biomedical Engineering

**V & VI Semester Examinations 2012-2013**

**Semester Pattern  
(CREDIT GRADE SYSTEM)**



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Price Rs. ....../-

Published by  
**Dineshkumar Joshi**  
Registrar,  
Sant Gadge Baba  
Amravati University  
Amravati - 444 602

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**SANT GADGE BABA AMRAVATI UNIVERSITY**

**SPECIAL NOTE FOR INFORMATION OF THE STUDENTS**

- (1) Notwithstanding anything to the contrary, it is notified for general information and guidance of all concerned that a person, who has passed the qualifying examination and is eligible for admission only to the corresponding next higher examination as an ex-student or an external candidate, shall be examined in accordance with the syllabus of such next higher examination in force at the time of such examination in such subjects papers or combination of papers in which students from University Departments or Colleges are to be examined by the University.
- (2) Be it known to all the students desirous to take examination/s for which this prospectus has been prescribed should, if found necessary for any other information regarding examinations etc., refer the University Ordinance Booklet the various conditions/provisions pertaining to examination as prescribed in the following Ordinances.

Ordinance No. 1	:	Enrolment of Students.
Ordinance No. 2	:	Admission of Students
Ordinance No. 4	:	National cadet corps
Ordinance No. 6	:	Examinations in General (relevent extracts)
Ordinance No. 18/2001:		An Ordinance to provide grace marks for passing in a Head of passing and Improvement of Division (Higher Class) and getting Distinction in the subject and condonation of defficiency of marks in a subject in all the faculties prescribed by the Statute No.18, Ordinance 2001.
Ordinance No. 9	:	Conduct of Examinations (relevent extracts)
Ordinance No. 10	:	Providing for Exemptions and Compartments
Ordinance No. 19	:	Admission of Candidates to Degrees.

- Ordinance No. 109 : Recording of a change of name of a University student in the records of the University.
- Ordinance No. 5/2010 : For improvement of Division/Grade.
- Ordinance No.19/2001 : An Ordinance for Central Assessment Programme, Scheme of Evaluation and Moderation of answerbooks and preparation of results of the examinations, conducted by the University, Ordinance 2001.

**Dineshkumar Joshi**

Registrar

Sant Gadge Baba Amravati University

**PATTERN OF QUESTION PAPER ON THE UNIT SYSTEM**

The pattern of question paper as per unit system will be broadly based on the following pattern.

- (1) Syllabus has been divided into units equal to the number of question to be answered in the paper. On each unit there will be a question either a long answer type or a short answer type.
- (2) Number of question will be in accordance with the unit prescribed in the syllabi for each paper i.e. there will be one question on each unit.
- (3) For every question long answer type or short answer type there will be an alternative choice from the same unit. However, there will be no internal choice in a question.
- (4) Division of marks between long answer and short answer type question will be in the ratio of 40 and 60.
- (5) Each short answer type question shall Contain 4 to 8 short sub question with no internal choice.

**DIRECTION**

No. 31/2011

Date : 10-06-2011

**Subject :- Schemes of teaching & examinations of III to VIII/X Semesters as per Credit Grade System of various branches in the faculty of Engineering & Technology.**

Whereas faculty of Engineering & Technology in its meeting held on 6<sup>th</sup> June, 2011 vide Item No.39 accepted and recommended schemes of teaching & examinations of semesters III to VIII/X as per Credit Grade System of various branches in the faculty of Engineering & Technology for its implementation from the session 2011-2012 in phase wise manner,

AND

Whereas the schemes of teaching & examinations of semesters III to VIII/X as per Credit Grade System of various branches in the faculty of Engineering & Technology were accepted by the Hon'ble Vice Chancellor u/s Section 14(7) of M.U.Act, 1994 on behalf on Academic Council on 9<sup>th</sup> April, 2011,

AND

Whereas these schemes of teaching & examinations of various branches as per Credit Grade System in the faculty of Engineering & Technology are required to be regulated by the Regulation,

AND

Whereas the process of making the Regulation is likely to take some time,

AND

Whereas the schemes of various branches as per Credit Grade System in the faculty of Engineering & Technology are to be implemented from the academic session 2011-2012,

AND

Whereas syllabi of various branches in the faculty of Engineering & Technology are to be sent for printing,

Now, therefore, I, Dr.Mohan K.Khedkar, Vice-Chancellor of Sant Gadge Baba Amravati University in exercise of powers conferred upon me under sub section (8) of Section 14 of the Maharashtra Universities Act,1994 hereby direct as under :-

- 1) This Direction shall be called "Schemes of teaching & examinations of III to VIII/X Semesters as per Credit Grade System of various branches in the faculty of Engineering & Technology, Direction, 2011".
- 2) This Direction shall come into force from the date of its issuance.
- 3) Schemes of teaching and examinations of III to VIII/X semesters as per Credit Grade System of the following branches shall be as per respective Appendices appended with this Direction :-

**BRANCH****Appendix No.**

1) Civil Engineering	A
2) Mechanical Engineering	B
3) Production Engineering	C
4) Electrical Engineering (Electronics & Power)	D
5) Electrical and Electronics Engineering	E
6) Electrical Engineering (Electrical & Power)	F
7) Electrical Engineering	G
8) Electronics & Telecommunications Engineering	H
9) Electronics Engineering	I
10) Instrumentation Engineering	J
11) Computer Science & Engineering	K
12) Computer Engineering	L
13) Architecture	M
14) Textile Engineering	N
15) Chemical Engineering	O
16) Chemical Technology (Polymer) (Plastic) Technology	P
17) Chemical Technology (Food, Pulp & Paper, Oil & Paint and Petrochemical Technology)	Q
18) Information Technology	R
19) Biomedical Engineering	S

sd/-

Dr.Mohan K.Khedkar  
Vice Chancellor

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**FOUR YEAR DEGREE COURSE IN CIVIL ENGINEERING**  
**SEMESTER PATTERN ( CREDIT GRADE SYSTEM)**  
**SEMESTER - FIFTH**

Appendix - A

			TEACHING SCHEME					EXAMINATION SCHEME								
Sr. No.	Subject Code	Subject	HOURS / WEEK			Total HOURS/WEEK	CREDITS	THEORY				PRACTICAL				
			Lecture	Tutorial	PD			DURATION OF PAPER (Hr.)	MAX. MARKS THEORY PAPER	MAX. MARKS COLLEGE ASSESSMENT	TOTAL	MIN. PASSING MARKS	MAX. MARKS		TOTAL	MIN. PASSING MARKS
				EXTERNAL	INTERNAL											
<b>THEORY</b>																
01	5CE01	Reinforced Cement Concrete-II	3	1	-	4	4	4	80	20	100	40	-	-	-	-
02	5CE02	Fluid Mechanics-II	3	1	-	4	4	3	80	20	100	40	-	-	-	-
03	5CE03	Building Planning & CAD	2	-	-	2	2	4	80	20	100	40	-	-	-	-
04	5CE04	Surveying-II	4	-	-	4	4	3	80	20	100	40	-	-	-	-
05	5FECE05	Free Elective-I	3	-	-	3	3	3	80	20	100	40	-	-	-	-
06	5CE06	Communication Skills	2	-	-	2	2	2	40	10	50	20	-	-	-	-
<b>PRACTICALS / DRAWING / DESIGN</b>																
07	5CE07	Fluid Mechanics-II - Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
08	5CE08	Building Planning & CAD-lab	-	-	4	4	2	-	-	-	-	-	25	25	50	25
09	5CE09	Surveying-II - Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
10	5CE10	Communication Skills-Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
<b>Total</b>			<b>17</b>	<b>2</b>	<b>10</b>	<b>29</b>	<b>24</b>	<b>550</b>				<b>200</b>				
<b>GRAND TOTAL : 750</b>																
Free Elective I : (i) Introduction To Earthquake Engineering (ii) Basics of Building Construction (iii) Watershed Management																
<b>SEMESTER : SIXTH</b>																
<b>THEORY</b>																
01	6CE01	Numerical Methods & Computer Programming	4	-	-	4	4	3	80	20	100	40	-	-	-	-
02	6CE02	Structural Design-I	4	-	-	4	4	4	80	20	100	40	-	-	-	-
03	6CE03	Water Resources Engineering-I	3	-	-	3	3	3	80	20	100	40	-	-	-	-
04	6CE04	Transportation Engineering-II	3	1	-	4	4	3	80	20	100	40	-	-	-	-
05	6FECE05	Free Elective-II	3	-	-	3	3	3	80	20	100	40	-	-	-	-
06	6CE06	Estimating & Costing	3	1	-	4	4	4	80	20	100	40	-	-	-	-
<b>PRACTICALS / DRAWING / DESIGN</b>																
07	6CE07	Numerical Methods & Computer Programming - Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
08	6CE08	Structural Design-I - Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
09	6CE09	Estimating & Costing-Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
10	6CE10	Minor Project - Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
<b>Total</b>			<b>18</b>	<b>2</b>	<b>10</b>	<b>30</b>	<b>26</b>	<b>600</b>				<b>200</b>				
<b>GRAND TOTAL : 800</b>																
Free Elective II : (i) Disaster Management (ii) Environmental Management																

Note: Students will have to opt the Free Electives offered from other courses of their College / Institution / University Department.

**FOUR YEAR DEGREE COURSE IN MECHANICAL ENGINEERING**  
**SEMESTER PATTERN ( CREDIT GRADE SYSTEM)**  
**SEMESTER - FIFTH**

Appendix - B

Sr. No.	Subject Code	Subject	TEACHING SCHEME				EXAMINATION SCHEME									
			HOURS / WEEK			CREDITS	THEORY				PRACTICAL					
			Lecture	Tutorial	P/D		Total HOURS/WEEK	DURATION OF PAPER (Hr.)	MAX. MARKS THEORY PAPER	MAX. MARKS COLLEGE ASSESSMENT	TOTAL	MIN. PASSING MARKS	MAX. MARKS		TOTAL	MIN. PASSING MARKS
EXTERNAL		INTERNAL														
<b>THEORY</b>																
01	SME01	Production Technology	4	-	-	4	4	3	80	20	100	40	-	-	-	-
02	SME02	Heat Transfer	4	1	-	5	5	3	80	20	100	40	-	-	-	-
03	SME03	Measurement Systems	4	-	-	4	4	3	80	20	100	40	-	-	-	-
04	SME04	Theory of Machines-I	3	1	-	4	4	3	80	20	100	40	-	-	-	-
05	SFEME05	Free Elective-I	3	-	-	3	3	3	80	20	100	40	-	-	-	-
<b>PRACTICALS / DRAWING / DESIGN</b>																
06	SME06	Production Technology-Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
07	SME07	Heat Transfer-Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
08	SME08	Measurement Systems-Lab	-	-	2	2	1	-	-	-	-	-	-	25	25	12
09	SME09	Theory of Machines-I-Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
10	SME10	Computer Software Applications-I-Lab	-	-	2	2	2	-	-	-	-	-	25	25	50	25
Total			18	2	10	30	26	500					225			
<b>GRAND TOTAL : 725</b>																
<b>Free Elective-I 1) Manufacturing Techniques 2) Ergonomics 3) Production Management 4) Project Management</b>																
<b>SEMESTER : SIXTH</b>																
<b>THEORY</b>																
01	6ME01	Fluid Power-II	4	1	-	5	5	3	80	20	100	40	-	-	-	-
02	6ME02	Computer Software Applications	3	-	-	3	3	3	80	20	100	40	-	-	-	-
03	6ME03	Control System Engineering	4	-	-	4	4	3	80	20	100	40	-	-	-	-
04	6ME04	Theory of Machines-II	4	1	-	5	5	3	80	20	100	40	-	-	-	-
05	6FEME05	Free Elective-II	3	-	-	3	3	3	80	20	100	40	-	-	-	-
06	6ME06	Communication Skills	2	-	-	2	2	2	40	10	50	20	-	-	-	-
<b>PRACTICALS / DRAWING / DESIGN</b>																
07	6ME07	Fluid Power-II-Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
08	6ME08	Computer Software Applications-II-Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
09	6ME09	Theory of Machines-II-Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
10	6ME10	Communication Skills-Lab	-	-	2	2	2	-	-	-	-	-	25	25	50	25
Total			20	2	8	30	26	550					200			
<b>GRAND TOTAL : 750</b>																
<b>Free Elective-II 1) Automobile Engineering 2) Non-conventional Energy Systems 3) Energy Management</b>																

Note : Students will have to opt the free electives offered from other courses of their College / Institution / University Department

**FOUR YEAR DEGREE COURSE IN BACHELOR OF ENGINEERING**  
**BRANCH : ELECTRICAL ENGINEERING (ELECTRONICS & POWER)- SEMESTER PATTERN ( CREDIT GRADE SYSTEM)**  
**SEMESTER - FIFTH**

Appendix - C

Sr. No.	Subject Code	Subject	TEACHING SCHEME					EXAMINATION SCHEME														
			HOURS / WEEK			Total HOURS/WEEK	CREDITS	THEORY				PRACTICAL										
			Lecture	Tutorial	P/D			DURATION OF PAPER (Hr.)	MAX. MARKS THEORY PAPER	MAX. MARKS COLLEGE ASSESSMENT	TOTAL	MIN. PASSING MARKS	MAX. MARKS		TOTAL	MIN. PASSING MARKS						
EXTERNAL	INTERNAL																					
<b>THEORY</b>																						
01	5EP01	Control Systems - I	4	-	-	4	4	3	80	20	100	40	-	-	-	-						
02	5EP02	Microprocessor & Microcontroller	4	-	-	4	4	3	80	20	100	40	-	-	-	-						
03	5EP03	Electrical Machines - II	4	-	-	4	4	3	80	20	100	40	-	-	-	-						
04	5EP04	Signals & Systems	4	-	-	4	4	3	80	20	100	40	-	-	-	-						
05	5FEPE05	Free Elective-I	3	-	-	3	3	3	80	20	100	40	-	-	-	-						
06	5EP06	Communication Skills	2	-	-	2	2	2	40	10	50	20	-	-	-	-						
<b>PRACTICALS / DRAWING / DESIGN</b>																						
07	5EP07	Control Systems - I -Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25						
08	5EP08	Microprocessor & Microcontroller -Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25						
09	5EP09	Electrical Machines - II- Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25						
10	5EP10	Communication Skills- Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25						
<b>TOTAL</b>			21	-	8	29	25				550				200							
													<b>TOTAL</b>				750					

Free Elective -I 1) Energy Audit &amp; Management 2) Electrical Drives

Semester : Sixth																						
Sr. No.	Subject Code	Subject	TEACHING SCHEME					EXAMINATION SCHEME														
			HOURS / WEEK			Total HOURS/WEEK	CREDITS	THEORY				PRACTICAL										
			Lecture	Tutorial	P/D			DURATION OF PAPER (Hr.)	MAX. MARKS THEORY PAPER	MAX. MARKS COLLEGE ASSESSMENT	TOTAL	MIN. PASSING MARKS	MAX. MARKS		TOTAL	MIN. PASSING MARKS						
EXTERNAL	INTERNAL																					
<b>THEORY</b>																						
01	6EP01	Electrical Power - I	4	-	-	4	4	3	80	20	100	40	-	-	-	-						
02	6EP02	Optimisation Techniques	4	-	-	4	4	3	80	20	100	40	-	-	-	-						
03	6EP03	Power Electronics	4	-	-	4	4	3	80	20	100	40	-	-	-	-						
04	6EP04	Computer Aided Machine Design	4	-	-	4	4	3	80	20	100	40	-	-	-	-						
05	6FEPE05	Free Elective-II	3	-	-	3	3	3	80	20	100	40	-	-	-	-						
06	6EP06	Electrical Energy Utilisation	4	-	-	4	4	3	80	20	100	40	-	-	-	-						
<b>PRACTICALS / DRAWING / DESIGN</b>																						
07	6EP07	Power Electronics - I Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25						
08	6EP08	Computer Aided Machine Design Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25						
09	6EP09	Electrical Energy Utilisation Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25						
<b>TOTAL</b>			23	-	6	29	26				600				150							
													<b>TOTAL</b>				750					

Free Elective -II 1) Electrical Estimating &amp; Costing 2) Power Supply Systems

Note : Students will have to opt the free electives offered from other courses of their College / Institution / University Department

**FOUR YEAR DEGREE COURSE IN BACHELOR OF ENGINEERING**  
**BRANCH : ELECTRICAL & ELECTRONICS ENGINEERING - SEMESTER PATTERN ( CREDIT GRADE SYSTEM)**  
**SEMESTER - FIFTH**

Appendix - D

Sr. No.	Subject Code	Subject	TEACHING SCHEME				EXAMINATION SCHEME									
			HOURS / WEEK			Total HOURS/WEEK	CREDITS	THEORY				PRACTICAL				
			Lecture	Tutorial	P/D			DURATION OF PAPER (Hr.)	MAX. MARKS THEORY PAPER	MAX. MARKS COLLEGE ASSESMENT	TOTAL	MIN. PASSING MARKS	MAX. MARKS		TOTAL	MIN. PASSING MARKS
EXTERNAL	INTERNAL															
<b>THEORY</b>																
01	5EX01	Control Systems	4	-	-	4	4	3	80	20	100	40	-	-	-	-
02	5EX02	Digital Electronics	4	-	-	4	4	3	80	20	100	40	-	-	-	-
03	5EX03	Electrical Machines - II	4	-	-	4	4	3	80	20	100	40	-	-	-	-
04	5EX04	Electrical Power - I	4	-	-	4	4	3	80	20	100	40	-	-	-	-
05	5FEEX05	Free Elective-I	3	-	-	3	3	3	80	20	100	40	-	-	-	-
06	5EX06	Communication Skills	2	-	-	2	2	2	40	10	50	20	-	-	-	-
<b>PRACTICALS / DRAWING / DESIGN</b>																
07	5EX07	Control Systems Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
08	5EX08	Digital Electronics Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
09	5EX09	Electrical Machines - II Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
10	5EX10	Communication Skills Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
<b>TOTAL</b>			21	-	8	29	25				550				200	
<b>TOTAL</b>															750	

Free Elective -I 1) Energy Audit &amp; Management 2) Electrical Drives

Semester : Sixth																
Sr. No.	Subject Code	Subject	TEACHING SCHEME				EXAMINATION SCHEME									
			HOURS / WEEK			Total HOURS/WEEK	CREDITS	THEORY				PRACTICAL				
			Lecture	Tutorial	P/D			DURATION OF PAPER (Hr.)	MAX. MARKS THEORY PAPER	MAX. MARKS COLLEGE ASSESMENT	TOTAL	MIN. PASSING MARKS	MAX. MARKS		TOTAL	MIN. PASSING MARKS
EXTERNAL	INTERNAL															
<b>THEORY</b>																
01	6EX01	Digital Signal Processing	4	-	-	4	4	3	80	20	100	40	-	-	-	-
02	6EX02	Optimisation Techniques	4	-	-	4	4	3	80	20	100	40	-	-	-	-
03	6EX03	Electrical Power - II	4	-	-	4	4	3	80	20	100	40	-	-	-	-
04	6EX04	Microprocessor & Microcontroller	4	-	-	4	4	3	80	20	100	40	-	-	-	-
05	6EX05	Free Elective-II	3	-	-	3	3	3	80	20	100	40	-	-	-	-
06	6EX06	Power Electronics - I	4	-	-	4	4	3	80	20	100	40	-	-	-	-
<b>PRACTICALS / DRAWING / DESIGN</b>																
07	6EX07	Electrical Power - II Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
08	6EX08	Microprocessor & Microcontroller Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
09	6EX09	Power Electronics - I Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
<b>TOTAL</b>			23	-	6	29	26				600				150	
<b>TOTAL</b>															750	

Free Elective -II 1) Electrical Estimating &amp; Costing 2) Power Supply Systems

Note : Students will have to opt the free electives offered from other courses of their College / Institution / University Department

**FOUR YEAR DEGREE COURSE IN BACHELOR OF ENGINEERING**  
**BRANCH : ELECTRICAL ENGINEERING ( ELECTRICAL & POWER) SEMESTER PATTERN (CREDIT GRADE SYSTEM)**

**Appendis - E**

<b>Semester : Fifth</b>																	
Sl. No.	Subject Code	Subject	TEACHING SCHEME					EXAMINATION SCHEME									
			HOURS / WEEK			CREDITS	THEORY					PRACTICAL					
			Lecture	Tutorial	PD		Total HOURS/WEEK	Duration of Paper (Hr.)	Max. Marks Theory Paper	Max. Marks College Assessment	Total	Min. Passing Marks	Max. Marks		Total	Min. Passing Marks	
EXTERNAL		INTERNAL															
<b>THEORY</b>																	
01	5EL01	Control Systems - I	4	-	-	4	4	3	80	20	100	40	-	-	-	-	
02	5EL02	Microprocessor & Microcontroller	4	-	-	4	4	3	80	20	100	40	-	-	-	-	
03	5EL03	Electrical Machines - II	4	-	-	4	4	3	80	20	100	40	-	-	-	-	
04	5EL04	Signals & Systems	4	-	-	4	4	3	80	20	100	40	-	-	-	-	
05	5FEEL05	Free Elective-I	3	-	-	3	3	3	80	20	100	40	-	-	-	-	
06	5EL06	Communication Skills	2	-	-	2	2	2	40	10	50	20	-	-	-	-	
<b>TOTAL</b>			<b>21</b>	<b>-</b>	<b>8</b>	<b>29</b>	<b>25</b>				<b>500</b>				<b>200</b>		
<b>TOTAL</b>															<b>750</b>		

Free Elective -I 1) Energy Audit & Management 2) Electrical Drives

<b>Semester : Sixth</b>																	
Sl. No.	Subject Code	Subject	TEACHING SCHEME					EXAMINATION SCHEME									
			HOURS / WEEK			CREDITS	THEORY					PRACTICAL					
			Lecture	Tutorial	PD		Total HOURS/WEEK	Duration of Paper (Hr.)	Max. Marks Theory Paper	Max. Marks College Assessment	Total	Min. Passing Marks	Max. Marks		Total	Min. Passing Marks	
EXTERNAL		INTERNAL															
<b>THEORY</b>																	
01	6EL01	Electrical Power - I	4	-	-	4	4	3	80	20	100	40	-	-	-	-	
02	6EL02	Optimization Techniques	4	-	-	4	4	3	80	20	100	40	-	-	-	-	
03	6EL03	Power Electronics	4	-	-	4	4	3	80	20	100	40	-	-	-	-	
04	6EL04	Computer Aided Machine Design	4	-	-	4	4	3	80	20	100	40	-	-	-	-	
05	6FEEL05	Free Elective-II	3	-	-	3	3	3	80	20	100	40	-	-	-	-	
06	6EL06	Electrical Energy Utilisation	4	-	-	4	4	3	80	20	100	40	-	-	-	-	
<b>TOTAL</b>			<b>23</b>	<b>-</b>	<b>6</b>	<b>29</b>	<b>26</b>				<b>600</b>				<b>150</b>		
<b>TOTAL</b>															<b>750</b>		

Free Elective -II 1) Electrical Estimating & Costing 2) Power Supply Systems

Note : Students will have to opt the free electives offered from other courses of their College / Institution / University Department



**FOUR YEAR DEGREE COURSE IN BACHELOR OF ENGINEERING**  
**BRANCH : ELECTRICAL ENGINEERING - SEMESTER PATTERN (CREDIT GRADE SYSTEM)**  
**SEMESTER - FIFTH**

Appendix - F

Sr. No.	Subject Code	Subject	TEACHING SCHEME					EXAMINATION SCHEME								
			HOURS / WEEK			Total HOURS/WEEK	CREDITS	THEORY				PRACTICAL				
			Lecture	Tutorial	PID			Duration of Paper (Hr.)	Max. Marks Theory Paper	Max. Marks College Assessment	Total	Min. Passing Marks	Max. Marks		Total	Min. Passing Marks
<b>THEORY</b>																
01	5EE01	Control Systems - I	4	-	-	4	4	3	80	20	100	40	-	-	-	-
02	5EE02	Microprocessor & Microcontroller	4	-	-	4	4	3	80	20	100	40	-	-	-	-
03	5EE03	Electrical Machines - II	4	-	-	4	4	3	80	20	100	40	-	-	-	-
04	5EE04	Signals & Systems	4	-	-	4	4	3	80	20	100	40	-	-	-	-
05	5FEEE05	Free Elective-I	3	-	-	3	3	3	80	20	100	40	-	-	-	-
06	5EE06	Communication Skills	2	-	-	2	2	2	40	10	50	20	-	-	-	-
<b>PRACTICALS / DRAWING / DESIGN</b>																
07	5EE07	Control Systems -Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
08	5EE08	Microprocessor & Microcontroller -Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
09	5EE09	Electrical Machines - II -Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
10	5EE10	Communication Skills-Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
TOTAL			21	-	8	29	25							200		
<b>TOTAL</b>														750		

Free Elective -I 1) Energy Audit &amp; Management 2) Electrical Drives

Semester : Sixth																
Sr. No.	Subject Code	Subject	TEACHING SCHEME					EXAMINATION SCHEME								
			HOURS / WEEK			Total HOURS/WEEK	CREDITS	THEORY				PRACTICAL				
			Lecture	Tutorial	PID			Duration of Paper (Hr.)	Max. Marks Theory Paper	Max. Marks College Assessment	Total	Min. Passing Marks	Max. Marks		Total	Min. Passing Marks
<b>THEORY</b>																
01	6EE01	Electrical power - I	4	-	-	4	4	3	80	20	100	40	-	-	-	-
02	6EE02	Optimisation Techniques	4	-	-	4	4	3	80	20	100	40	-	-	-	-
03	6EE03	Power Electronics	4	-	-	4	4	3	80	20	100	40	-	-	-	-
04	6EE04	Computer Aided Machine Design	4	-	-	4	4	3	80	20	100	40	-	-	-	-
05	6FEEE05	Free Elective-II	3	-	-	3	3	3	80	20	100	40	-	-	-	-
06	6EE06	Electrical Energy Utilisation	4	-	-	4	4	3	80	20	100	40	-	-	-	-
<b>PRACTICALS / DRAWING / DESIGN</b>																
07	6EE07	Power Electronics - I -Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
08	6EE08	Computer Aided Machine Design -Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
09	6EE09	Electrical Energy Utilisation - Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
TOTAL			23	-	6	29	26							150		
<b>TOTAL</b>														750		

Free Elective -II 1) Electrical Estimating &amp; Costing 2) Power Supply Systems

Note : Students will have to opt the free electives offered from other courses of their College / Institution / University Department

**FOUR YEAR DEGREE COURSE IN BACHELOR OF ENGINEERING**  
**BRANCH : INFORMATION TECHNOLOGY - SEMESTER PATTERN (CREDIT GRADE SYSTEM)**  
**SEMESTER - FIFTH**

Appendix - G

Sr. No.	Subject Code	Subject	TEACHING SCHEME					EXAMINATION SCHEME														
			HOURS / WEEK			Total HOURS/WEEK	CREDITS	THEORY				PRACTICAL										
			Lecture	Tutorial	P/D			DURATION OF PAPER (Hr.)	MAX. MARKS THEORY PAPER	MAX. MARKS COLLEGE ASSESSMENT	TOTAL	MIN. PASSING MARKS	MAX. MARKS		TOTAL	MIN. PASSING MARKS						
		EXTERNAL	INTERNAL																			
<b>THEORY</b>																						
01	5IT01	Operating Systems	4	-	-	4	4	3	80	20	100	40	-	-	-	-						
02	5IT02	Digital Integrated Circuits	4	-	-	4	4	3	80	20	100	40	-	-	-	-						
03	5IT03	Computer Architecture & Organisation	4	-	-	4	4	3	80	20	100	40	-	-	-	-						
04	5IT04	Communication Skills	2	-	-	2	2	2	40	10	50	20	-	-	-	-						
05	5FEIT05	Free Elective I*	3	-	-	3	3	3	80	20	100	40	-	-	-	-						
<b>PRACTICALS / DRAWING / DESIGN</b>																						
06	5IT06	Operating Systems-Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25						
07	5IT07	Digital Integrated Circuits-Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25						
08	5IT08	Communication Skills-Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25						
09	5IT09	Computer Lab-III (VC++)	1	-	2	3	2	-	-	-	-	-	25	25	50	25						
<b>TOTAL</b>			<b>18</b>	<b>-</b>	<b>8</b>	<b>26</b>	<b>22</b>				<b>450</b>				<b>200</b>							
													<b>TOTAL</b>		<b>650</b>							
<b>Free Elective I* (i) Introduction to Computer Networks (ii) IT Ethics &amp; Practices</b>													<b>Semester :SIXTH</b>									
<b>THEORY</b>																						
01	6IT01	Principles of Management	4	-	-	4	4	3	80	20	100	40	-	-	-	-						
02	6IT02	Database Management Systems	4	-	-	4	4	3	80	20	100	40	-	-	-	-						
03	6IT03	Theory of Computation	4	-	-	4	4	3	80	20	100	40	-	-	-	-						
04	6IT04	Computer Networks	4	-	-	4	4	3	80	20	100	40	-	-	-	-						
05	6FEIT05	Free Elective II*	3	-	-	3	3	3	80	20	100	40	-	-	-	-						
<b>PRACTICALS / DRAWING / DESIGN</b>																						
06	6IT06	Database Management Systems-Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25						
07	6IT07	Computer Networks-Labs	-	-	2	2	1	-	-	-	-	-	25	25	50	25						
08	6IT08	Computer Lab-IV (UML)	1	-	2	3	2	-	-	-	-	-	25	25	50	25						
<b>TOTAL</b>			<b>20</b>	<b>-</b>	<b>6</b>	<b>26</b>	<b>23</b>				<b>500</b>				<b>150</b>							
													<b>TOTAL</b>		<b>650</b>							

Free Elective II\* (i) E Commerce (ii) Knowledge Management

Note : Students will have to opt the free electives offered from other courses of their College / Institution / University Department

**FIVE YEAR DEGREE COURSE IN BACHELOR OF ENGINEERING  
BRANCH OF ARCHITECTURE - SEMESTER PATTERN (CREDIT GRADE SYSTEM)**

**SEMESTER : FIFTH**

**Appendix - H**

Sr. No.	Subject Code	Subject	TEACHING SCHEME					EXAMINATION SCHEME								
			HOURS / WEEK					THEORY				PRACTICAL				
			Lecture	Tutorial	P/D	Total HOURS/WEEK	CREDITS	DURATION OF PAPER (Hr.)	MAX. MARKS THEORY PAPER	MAX. MARKS COLLEGE ASSESSMENT	TOTAL	MIN. PASSING MARKS	MAX. MARKS		TOTAL	MIN. PASSING MARKS
EXTERNAL		INTERNAL														
<b>THEORY</b>																
1	05AR01	Building Materials & Construction - V	3	-	-	3	3	4	80	20	100	40	-	-	-	-
2	05AR02	Building Services & Equipment	3	-	-	3	3	4	80	20	100	40	-	-	-	-
3	05AR03	Architectural Structure - IV	2	1	-	3	3	3	80	20	100	40	-	-	-	-
4	05AR04	Specification	2	-	-	2	2	3	80	20	100	40	-	-	-	-
5	05FEAR05	Free Elective -I	3	-	-	3	3	3	80	20	100	40	-	-	-	-
<b>SESSIONAL / PRACTICAL</b>																
6	05AR06	Architectural Design Studio - V	-	-	6	6	6	-	-	-	-	-	75	75	150	75
7	05AR07	Building Materials & Construction Studio - V	-	-	4	4	2	-	-	-	-	-	25	25	50	25
8	05AR08	Interior Design -I	-	-	2	2	1	-	-	-	-	-	25	25	50	25
9	05AR09	Working Drawing - II	-	-	4	4	2	-	-	-	-	-	25	25	50	25
<b>TOTAL</b>			13	1	16	30	25			<b>500</b>					<b>300</b>	
														<b>TOTAL</b>		<b>800</b>
Note: Consider one hour Lecture / Tutorial and P/D is equal to one credit for the subjects of Architectural Design and for all other subjects consider 1hour Lecture & Tutorial = 1credit & 2hour Practical /Design studio. = 1 credit .																
<b>Semester : Sixth</b>																
<b>THEORY</b>																
1	06AR01	Architectural Design - VI	2	-	-	2	2	18	150	-	150	60	-	-	-	-
2	06AR02	Building Materials & Construction - VI	3	-	-	3	3	4	80	20	100	40	-	-	-	-
3	06AR03	Architectural Structure - V	2	1	-	3	3	3	80	20	100	40	-	-	-	-
4	06AR04	Estimate & Costing	3	-	-	3	3	3	80	20	100	40	-	-	-	-
5	06FEAR05	Free Elective-II	3	-	-	3	3	3	80	20	100	40	-	-	-	-
6	06AR06	Acoustics & Illumination	3	-	-	3	3	3	80	20	100	40	-	-	-	-
<b>SESSIONAL / PRACTICAL</b>																
7	06AR07	Architectural Design Studio - VI	-	-	6	6	6	-	-	-	-	-	75	75	150	75
8	06AR08	Building Materials & Construction Studio - VI	-	-	4	4	2	-	-	-	-	-	25	25	50	25
9	06AR09	Interior Design -II	-	-	2	2	1	-	-	-	-	-	25	25	50	25
<b>TOTAL</b>			16	1	12	29	26			<b>650</b>					<b>250</b>	
														<b>TOTAL</b>		<b>900</b>

Free Elective-II (1) Climate Resonsive Architecture (2) Sustainable Architecture

Noet : Students will have to opt the free electives offered from other courses of their college / Institution / University Department

**FOUR YEAR DEGREE COURSE IN BACHELOR OF ENGINEERING**  
**BRANCH : INSTRUMENTATION ENGINEERING - SEMESTER PATTERN (CREDIT GRADE SYSTEM)**

**SEMESTER : FIFTH**

**Appendix - I**

Sr. No.	Subject Code	Subject	TEACHING SCHEME					EXAMINATION SCHEME								
			HOURS / WEEK				CREDITS	THEORY					PRACTICAL			
			Lecture	Tutorial	P/D	Total HOURS/WEEK		DURATION OF PAPER (Hr.)	MAX. MARKS THEORY PAPER	MAX. MARKS COLLEGE ASSESSMENT	TOTAL	MIN. PASSING MARKS	MAX. MARKS		TOTAL	MIN. PASSING MARKS
EXTERNAL	INTERNAL	TOTAL	MIN. PASSING MARKS													
<b>THEORY</b>																
01	SIE01	Introduction to Microprocessor & Microcontrollers	4	-	-	4	4	3	80	20	100	40	-	-	-	-
02	SIE02	Power Electronics	4	-	-	4	4	3	80	20	100	40	-	-	-	-
03	SIE03	Control Systems	4	-	-	4	4	3	80	20	100	40	-	-	-	-
04	SIE04	Electronics Instrumentation	4	-	-	4	4	3	80	20	100	40	-	-	-	-
05	5FEIE05	Free Elective- I	3	-	-	3	3	3	80	20	100	40	-	-	-	-
06	SIE06	Biomedical Instrumentation	4	-	-	4	4	3	80	20	100	40	-	-	-	-
<b>PRACTICALS / DRAWING / DESIGN</b>																
07	SIE07	Introduction to Microprocessors-Lab.	-	-	2	2	1	-	-	-	-	-	25	25	50	25
08	SIE08	Linear Integrated Circuits -Lab.	-	-	2	2	1	-	-	-	-	-	25	25	50	25
09	SIE09	Biomedical Instrumentation -Lab.	-	-	2	2	1	-	-	-	-	-	25	25	50	25
<b>TOTAL</b>			23	-	6	29	26			600					150	
													<b>TOTAL</b>		750	

Free Elective -I : 1) Sensor & Transducers , 2) Advance Sensors and Transmitters

<b>Semester : Sixth</b>																
Sr. No.	Subject Code	Subject	TEACHING SCHEME					EXAMINATION SCHEME								
			HOURS / WEEK				CREDITS	THEORY					PRACTICAL			
			Lecture	Tutorial	P/D	Total HOURS/WEEK		DURATION OF PAPER (Hr.)	MAX. MARKS THEORY PAPER	MAX. MARKS COLLEGE ASSESSMENT	TOTAL	MIN. PASSING MARKS	MAX. MARKS		TOTAL	MIN. PASSING MARKS
EXTERNAL	INTERNAL	TOTAL	MIN. PASSING MARKS													
<b>THEORY</b>																
01	6IE01	Control System Components	4	1	-	5	5	3	80	20	100	40	-	-	-	-
02	6IE02	Unit Operation	4	-	-	4	4	3	80	20	100	40	-	-	-	-
03	6IE03	Digital Circuits Design	4	-	-	4	4	3	80	20	100	40	-	-	-	-
04	6IE04	Analog and Digital Integrated Circuits	4	1	-	5	5	3	80	20	100	40	-	-	-	-
05	6FEIE05	Free Elective -II	3	-	-	3	3	3	80	20	100	40	-	-	-	-
06	6IE06	Communication Skills	2	-	-	2	2	2	40	10	50	20	-	-	-	-
<b>PRACTICALS / DRAWING / DESIGN</b>																
07	6IE07	Control System Components -Lab.	-	-	2	2	1	-	-	-	-	-	25	25	50	25
08	6IE08	Power Electronics-Lab.	-	-	2	2	1	-	-	-	-	-	25	25	50	25
09	6IE09	Communication Skills Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
<b>TOTAL</b>			21	2	6	29	26			550					150	
													<b>TOTAL</b>		700	

Free Elective-II : 1) Control system and Components 2) Industrial Automation & Process Control

Note : Students will have to opt the free electives offered from other courses of their College / Institution / University Department

**FOUR YEAR DEGREE COURSE IN BACHELOR OF ENGINEERING**  
**BRANCH : BIOMEDICAL ENGINEERING - SEMESTER PATTERN (CREDIT GRADE SYSTEM)**

Semester : Fifth														Appendix - J		
Sr. No.	Subject Code	Subject	TEACHING SCHEME					EXAMINATION SCHEME								
			HOURS / WEEK				Credits	THEORY				PRACTICAL				
			Lecture	Tutorial	P/D	Total HOURS/WEEK		DURATION OF PAPER (Hr.)	MAX. MARKS THEORY	MAX. MARKS COLLEGE ASSESSMENT	TOTAL	MIN. PASSING MARKS	MAX. MARKS		TOTAL	MIN. PASSING MARKS
		EXTERNAL		INTERNAL												
<b>THEORY</b>																
01	5BM01	Data Structures & Algorithms	4	-	-	4	4	3	80	20	100	40	-	-	-	-
02	5BM02	Bio Control Systems	4	-	-	4	4	3	80	20	100	40	-	-	-	-
03	5BM03	Bio Medical Instrumentation	4	-	-	4	4	3	80	20	100	40	-	-	-	-
04	5BM04	Communication Engineering	4	-	-	4	4	3	80	20	100	40	-	-	-	-
05	5FEBM05	Free Elective-I	3	-	-	3	3	c	80	20	100	40				
06	5BM06	Pathology & Microbiology	4	-	-	4	4	3	80	20	100	40	-	-	-	-
<b>PRACTICALS / DRAWING / DESIGN</b>																
07	5BM07	Data Structures & Algorithms-Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
08	5BM08	Bio Medical Instrumentation-Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
09	5BM09	Communication Engineering-Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
<b>TOTAL</b>			<b>23</b>	<b>0</b>	<b>6</b>	<b>29</b>	<b>26</b>				<b>600</b>				<b>150</b>	
<b>TOTAL 750</b>																
Free Elective I : (i) Medical Instrumentation (ii) Principles of Biomaterials and Biomechanics																
Semester : Sixth																
<b>THEORY</b>																
01	6BM01	Diagnostics and Therapeutic Equipments	4	-	-	4	4	3	80	20	100	40	-	-	-	-
02	6BM02	Microprocessors and Applications	4	-	-	4	4	3	80	20	100	40	-	-	-	-
03	6BM03	Radiological Equipments	4	1	-	5	5	3	80	20	100	40	-	-	-	-
04	6BM04	Physiological Modelling and Simulation	4	-	-	4	4	3	80	20	100	40	-	-	-	-
05	6FEBM05	Free Elective-II	3	-	-	3	3	3	80	20	100	40	-	-	-	-
06	6BM06	Communication Skills	2	-	-	2	2	2	40	10	50	20	-	-	-	-
<b>PRACTICALS / DRAWING / DESIGN</b>																
07	6BM07	Microprocessors and Applications-Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
08	6BM08	Physiological Modelling and Simulation-Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
09	6BM09	Communication Skills-Lab	-	-	2	2	1	-	-	-	-	-	25	25	50	25
10	6BM10	Medical Instrumentation-Lab	-	-	2	2	2	-	-	-	-	-	25	25	50	25
<b>TOTAL</b>			<b>21</b>	<b>1</b>	<b>8</b>	<b>30</b>	<b>27</b>				<b>550</b>				<b>200</b>	
<b>TOTAL 750</b>																

Free Elective II : (i) Modelling and Simulation (ii) Biomedical Image Processing

Note : Students will have to opt the free electives offered from other courses of their College / Institution / University Department

**SYLLABUS PRESCRIBED FOR  
BACHELOR OF ENGINEERING  
CIVIL ENGINEERING EXAMS.**

**SEMESTER PATTERN (CREDIT GRADE SYSTEM)**

**5CE01: REINFORCED CEMENT CONCRETE – II**

**SECTION – A**

- Unit I :** 1. Design of circular tanks with rigid and flexible base resting on firm ground by working stress method.  
2. Design of rectangular water tanks resting on firm ground by using IS code method (working stress method).

**LIMIT STATE METHOD:**

- Unit-II:** 1) Introduction to limit state method, basic concept of singly, doubly reinforced and flanged beams, shear and comparison with working stress method.  
2) Analysis and design of one way single span and continuous slabs.

- Unit-III** 1) Analysis and design of two way solid slabs.  
2) Staircases, Design of Dog legged type staircase only.

**SECTION-B**

**Unit-IV:** Analysis and complete design of beams, rectangular and flanged sections for bending moment and shear.

- Unit-V:** 1) Analysis and design of columns for axial load, uniaxial and biaxial bending. (Problem on uniaxial bending only)  
2) Design of Isolated footings: Square and rectangular footings subjected to axial load only, Design problem on footing with uniform & non-uniform depth.

- Unit-VI:** 1) Design of grid slab by I.S. code method.  
2) Detailing for earthquake resistant construction. Introduction, Cyclic behavior of concrete and reinforcement, significance of Ductility, Ductility of detailing for beams, Columns, joints & shear walls.

**Note:** Students should use the latest I.S. codes.

**BOOKS RECOMMENDED:**

1. Jain A.K.: Plain & Reinforced Concrete, Vol. I & II
2. Sinha S.K. & Roy S.K.: Fundamentals of RCC.
3. Pillai & Menon: RCC Design.
4. Dr.Shah V.L. & Karve S.R.: Limit State Design.

**5CE02: FLUID MECHANICS-II  
SECTION – A**

**Unit-I :** Turbulent flow through pipes: Karman-Prandtl's equation (No Proof), Nikuradse's experiment, Velocity distribution laws & universal resistance laws, Hydraulically smooth & rough pipes.

**Unit -II:** Uniform flow, Open channel flow, Types of flow, , geometric elements of rectangular & trapezoidal sections, Chezy's & Mannings equations, most efficient rectangular & trapezoidal section, Energy & momentum principles, Normal & critical depth, specific energy diagram, discharge diagram. Analysis of surface profile by Ven-Te-Chow method.

**Unit-III:** Gradually varied flow, Dynamic equation of G.V.F. with proof, Analysis of Surface profiles, single step method. Rapidly varied flow; Hydraulic jump in horizontal rectangular channel, specific force diagram, elements of jump, relation between conjugate depth.

**SECTION - B**

**Unit-IV:** Dimensional Analysis ; Buckingham's Pie theorem, it's application, similitude, Dimensionless numbers, Re, Fr, We, Predominant forces & their ratio, Model Analysis - Geometrically similar models, Reynolds law, Froudes law, Model study of spillways.

**Unit V :** Impact of jet on stationary & moving plates, symmetrical, asymmetrical curved vanes; Moment of momentum equation (statement only), velocity diagrams. Elements of Hydroelectric Plant, Hydraulic turbines; classification of turbines, Description of Pelton wheel & Francis turbine, calculation of work done, power & efficiency, specific speed.

**UnitVI:** Classification of pumps ; centrifugal pumps, main parts & working, velocity diagrams, work done, efficiency, priming of pumps, brief introduction of reciprocating pump, Jet pump, Submersible pump, Hydraulic Ram (No numerical).

**BOOKS RECOMMENDED:**

- 1) Modi P.N. & Seth S.M. : Hydraulics & Fluid Mechanics, SI Edition, Standard Book House, New Delhi-6
- 2) Ranga Raju : Open Channel Flow.
- 3) Dr. Jain A.K. : Fluid Mechanics.
- 4) Subramanya K. : Flow in Open Channel.
- 5) Chow V.T. : Open Channel Hydraulics.
- 6) Garde & Mirajgaonkar : Fluid Mechanics.

**SCE03 : BUILDING PLANNING AND CAD**  
**SECTION – A**

**Unit-I:** Introduction: Importance of building drawing for Civil Engineering in construction & estimation, Method of drawing – Selection of scales for various drawings, types of line, methods of dimensioning in architectural drawing.

Abbreviations & graphical symbols used in Civil Engineering Drawing as per IS : 962. Combined first angle & third angle method of projection. Layout of sheet for civil engineering drawing, Requirements of drawing as per plan sanctioning authorities.

**Unit-II:** Concept of line plan & working drawings of the building. Developing working drawings of the building from the given line plan Details to be incorporated in the working drawing. Necessity and use of working drawing. Concept of site plan, block plan and layout plan. Importance and details to be incorporated. Concept of foundation plan, importance and use. Developing working drawing and foundation plan for load bearing and framed structures. Plumbing & electric plan.

**SECTION - B**

**Unit-III:** Planning of residential building. Introduction, general principles of planning viz. aspect, prospect, roominess, privacy, grouping, circulation, ventilation, furniture requirement. Climate and design consideration. Orientation of buildings, requirement of the owner, alternatives of building types viz. individual bungalows, semidetached houses, row houses, apartments. Provision of mezzanine floor, balconies and porches in the building. Common utilities such as parking, security, water supply, sanitation, etc. for apartments. Criteria for earthquake resistant planning of building.

**Unit-IV:** Building rules and by laws, for residential buildings, conversion of land to non-agricultural lands, layout for a housing project. Types of public building and their requirements, planning of public building. Preparing line plans of different public buildings such as schools, commercial market, primary health center, workshop, college building, post-office. Free-hand sketching : Importance in Civil engineering. Free hand sketching of components of buildings and elevation features of building such as balconies, chajjas, etc. Perspective drawing, Staircase planning & drawing.

**UNIT-V: (Only for laboratory work)**

**AUTOCAD:** Understanding basic concepts such as Absolute, relative & world Co-ordinates, Drawing units, drawing limits, extend, layers, line types, object snapping, filters.

Drawing entities in AutoCAD/Felix CAD, various drawing commands, use of object snaps & filters, Editing the drawing different editing commands, Dimensioning commands, Text commands, Hatching commands viewing the drawing different views, view ports, zooming in & out, panning, saving & printing in different scales.

**IMPORTANT NOTE:-**

- 1) Theory questions only on unit first four units.
- 2) No theory questions on unit V

**BOOKS RECOMMENDED:**

- 1) Shah, Kale & Patki, Building Planning & Drawing, Tata McGraw-Hill publication
- 2) Dr. Kumar Swamy & Rao Swamy, Charotar publications
- 3) Chery R ,Auto cad Pocket reference, BPB Publication.

**SCE04 : SURVEYING-II**

**SECTION- A**

**Unit-I:** Tacheometry: Stadia methods, fixed hair and movable hair and tangential method, formulae for distance and reduce level determination. Theory of analytic lens, Beaman's stadia arc, Auto reduction tacheometer such as Jeffcot Hammer fennel.

**Unit-II :**

1. Curves : Classification, degree of curve, elements of circular and compound curves, theory and methods of setting out simple curves, Instrumental method of setting out compound curves.
2. Transition curves. : Ideal transition curves, characteristics methods of determination of length, Elements of different types and methods of setting out.

**Unit-III**

1. Triangulation : principles, classification of triangulation system, triangulation figures, their choice of station, phase of signals, towers, satellite station, reduction to center, field work, Reconnaissance, Inter-visibility, angular measurements.
2. Basenet, extension of Basenet, adjustment of field observation, errors in observation, method of least square, weighted observations, figure adjustment (Triangle only).

**SECTION B**

- Unit-IV:** 1. Hydrographic surveying: necessity, controls, shore line surveys, gauges, sounding equipments and procedure of taking soundings, methods of location of sounding, three point problem in hydrographic surveying, analytical and graphical methods. Station pointer.
2. Underground Surveying: surface alignment, correlation of surface and underground surveys; Weisbach triangle, transferring levels underground.

- Unit-V:** 1. Elements of photogrammetry: Basic definitions, terrestrial and aerial photography, scale of vertical photograph, Relief and relief displacements, heights from parallel measurements, flight planning, photographs required.
2. Remote sensing : Introduction, definitions, remote sensing systems, advantages over conventional system, energy interaction in the atmosphere, Indian remote sensing satellite series and their characteristics.

- Unit-VI:** 1. Field Astronomy : Elements of spherical trigonometry, Napier's rules of circular parts, celestial sphere, ecliptic, circumpolar stars, astronomical terms, Astronomical triangle, co-ordinate systems.
2. GIS & GPS : Components of geographical information system (GIS), advantages, function of GIS, advantages and disadvantages, global positioning system. (GPS), introduction, definitions, GPS receivers, antenna, advantages of GPS.

**BOOKS RECOMMENDED :**

1. D.Clark. : Plane and Geodetic Surveying Vol II
2. T.P.Kanetkar & S.V.Kulkarni : Surveying and Levelling Part II
3. B.C.Punmia : Surveying Vol. II and III
4. Prof.Agor : Surveying
5. Prof. Shahane : Advanced Surveying.

**5FECE05: FREE ELECTIVE-I****(i) INTRODUCTION TO EARTHQUAKE ENGINEERING****SECTION A**

**Unit-I:** Interior of earth, Engineering geology of earthquakes, plate tectonics, Seismicity of the world, tectonics features of India, Faults, Propagation of earthquake waves .

**Unit-II:** Quantification of earthquake (magnitude, energy, intensity of earthquake), Measurements of earthquake (accelerograph,

accelerogram recording), Determination of magnitude, Epicenter distance, Ground motion and their characteristics, Factors affecting ground motions.

**Unit-III:** Guidelines for achieving efficient seismic resistant planning, selection of sites, importance of architectural features in earthquake resistant buildings

**SECTION B**

**Unit-IV:** Projections & suspended parts, special construction features like separation of adjoining structure, crumble section, stair case etc, twisting of building, seismic effects on structures, inertia forces, horizontal & vertical shaking.

**Unit-V:** Behavior of masonry structure during earthquake, bands & reinforcement in masonry building opening in walls, importance of flexible structures,

**Unit-VI:** Behavior of R.C. building in past earthquakes. Concept of earthquake Resistant design, Introduction to IS: 1893

**Reference Books:**

- 1 Duggal S. K., Earthquake Resistant Design of Structures, Oxford University Press 2007
2. Amita Sinvhal; Understanding Earthquake Disasters, Tata McGraw Hill
3. P. N. Agrawal; Engineering Seismology Oxford & IBH Publishing
4. C.V.R.Murty; Earthquake Tips National Information Centre of Earthquake Engineering I I T Kanpur
5. Pankaj Agrawal & Manish Shrikhande ; Earthquake Resistant Design of Structures Prentice- Hall of India

**5FECE05: FREE ELECTIVE-I****(ii) BASICS OF BUILDING CONSTRUCTION****SECTION –A**

**Unit-I : Introduction:** Definition of building as per national building code, components of buildings and their function , Types of structure-load bearing structure and frame structures, their relative advantages and disadvantages, load bearing walls and partition walls. Types of foundation- Definition and necessity and types of foundations, precautions to be taken against failure of foundations

**Unit-II :** Stone Masonry- Technical term, general principles to be observed during construction, selection of stone masonry. Brick Masonry Construction- Technical term, general principles to be observed during construction, commonly used types of bonds



such as Stretcher, Header, English bond Flemish bond and their suitability.

**Unit-III:** Floors- Types of floors-Basement floor, ground floor and upper floor. Types of upper floors-R.C.C. slab floor, R.C.C. slab and beam floor, R.C.C. grid floor, R.C.C. flat slab floor. Floor Finishes-Types of flooring material, Shahabad , Kota, Granite, Ceramic tiles, Plain tiles, mosaic tiles ,glazed tiles ,different types of floor finishes , their suitability. Method of construction, criteria of selection. Roofs-Flat and pitched roof ,steel roof trusses-types and suitability ,fixing details at supports ,types of roof covering ,AC and GI sheets, acrylic sheets, fixing details of roof covering.

#### SECTION –B

**Unit IV:**Door –Purpose, criteria for location, size of door, door frames and its types, method of fixing Windows- Purpose, criteria for location, size and shapes of windows, types of windows and their suitability. Ventilators – Types and their suitability. Fixtures and Fastening for doors and windows. Glass- Types of glass and their suitability. Arches and Lintels - Types and their suitability. Details of R.C.C. lintels and chajja, precast lintels and arches

**Unit-V:** Stairs- Function, technical terms, criteria for location, types of staircases and their suitability. Plastering and Pointing- Necessity, types, processes of different types of plastering, defects in plaster work Painting and Coloring – Necessity, types, processes of painting and coloring to the wall surface, wooden surfaces, iron and steel surfaces, types of paints and their uses Scaffolding- Purposes, types, suitability.

**Unit VI:** Special Aspects of Construction, Damp proofing-causes of dampness, its effects, various methods of damp proofing, material used for damp proofing. Fire proof construction- Points to be observed during planning and construction. Fire protection requirement for a multistoried building, Sound proof construction –Sound absorbents and their characteristic. Joints-Expansion and construction joints necessity, details of expansion joint at foundation level and roof level of load bearing structure and framed structure, Provision of construction joints in slabs, beams and columns.

#### BOOKS RECOMMENDED:

- 1) Deshpande R.S.. and Vartak C.V.: A Treatise on Building Construction.
- 2) Sharma S.K. Kaul and B.K. :A.T.B. Building Construction ,S Chand and co.
- 3) Gurucharan Sing : Building Construction Engineering, Standard Book House ,Delhi-06

- 4) Sane L.S.: Construction Engineering, Manak Talas, Mumbai
- 5) Chudley R.: Construction Technology ,Volume I.II.III. and IV,Longmans Group Ltd.
- 6) ISE National Building code of India,1970

#### 5FECE05: FREE ELECTIVE-I

#### ( iii ) WATERSHED MANAGEMENT

#### SECTION-A

- Unit I Engineering Hydrology: Definition and its importance, Hydrological Cycle, Hydrologic equation. Storages, concept of storages, the watershed Water and Energy: Energy movement, quality of energy, geometry of energy. The energy budget, Instruments and limitations. The role of water in energy sphere.
- Unit II Precipitation: Forms, Types. Factor affecting, Measurement Evaporation: Processes, factor affecting, measurement and estimation Evapotranspiration: Processes, factor affecting, measurement and estimation Infiltration: Processes, factor affecting, measurement and infiltration indices
- Unit III Run-off: Factor affecting, estimation of runoff, Rainfall-Runoff co-relation Floods: Floods classification importance, estimation of flood, flood control techniques, Brief description of flood routing.

#### SECTION-B

- Unit IV Common aquifer: Exploration of ground water hydraulics of ground water flow- Measurement of permeability of formations, flow net and their construction . Boundary Conditions: Unconfined and confined, steady and unsteady flow in to wells and infiltration galleries.
- Unit V : Watershed development management-Definition, Need and scope, characterization of watershed criteria survey, Basic data collection and interpretation, Establishment of watershed research stations. Hydrographs: Typical flood Hydrograph, base flow separation, Unit hydrograph, S-curve hydrograph.
- Unit VI Rain water harvesting: Necessity, method of rain water harvesting, water harvesting potentially, elements of typical water harvesting system, cost of water harvesting. Roles of NGO's Government and Municipal Corporation Limitations, quality assurance of stored water.

#### Books Recommended:

- 1) Sharma R.K.: Hydrology and Water Resources Engineering .
- 2) Peter E.Black: Watershed Hydrology.
- 3) Dr. Reddy Jayarami P. :Hydrology, Laxmi Pub..Delhi.
- 4) R.N.Chaturvedi: Water Resources Systems,Planning and Management.
- 5) Raghunath H.M. :Hydrology,Wiley Eastern Ltd., New Delhi.
- 6) Subramanya S. : Hudrology, Tata McGRAW Hill

**5CE06: COMMUNICATION SKILLS**

**Unit I:** Word Study : synonym, antonym, meanings, matching words, adjectives, adverbs, prefix and suffix, correct forms of commonly misspelled words, understanding of the given passage. Comprehension over an unseen passage. Most commonly spoken sentences.

**Unit II :** (a) Verbal communication, its significance, types of written communication, organization of a text (titles, summaries, headings, sequencing, signaling, cueing etc.), important text factors (length of paragraph, sentences, words, clarification and text difficulty). Evaluation of written communication for its effectivity and subject content.

(b) Non-verbal communication, types of graphics and pictorial devices, body language.

**Unit III :**(a) Specific formats for written communication like business correspondence, formal reports, technical proposals, research papers and articles, advertising and graphics. Format for day-to- day written communication like application, notices, minutes, quotations, orders, enquiries etc.

(b) Oral communications - important objectives of interpersonal skills, (verbal and non-verbal), face to face communications, group discussion and personal interviews. Methodology of conduction of meetings, seminars, symposia, conferences and workshops.

**BOOKS RECOMMENDED :**

- 1) Krishna Mohan, Meera Banerjee : Developing Communication Skills, MacMillan India Limited.
- 2) Chrissie Wright (Editor) : Handbook of Practical Communication Skills, Jaico Pub. House.
- 3) Curriculum Development Centre, TTTI WR, Bhopal : A Course in Technical English, Somaiya Pub. Pvt. Ltd.]
- 4) F. Frank Candlin : General English for Technical Students, University of London Press Ltd.

**5CE07: FLUID MECHANICS -II – Lab****PRACTICALS –**

Minimum 8 practicals out of the list given below are to be performed: The practical examination shall consist of viva-voce based on theory & practicals.

1. Verification of momentum equation.
2. Determination of Chezy's coefficient.

3. Determination of coefficient of discharge of Venturiflume.
4. Study of Gradually Varied Flow.
5. Study of hydraulic jump, calculations of height of jump, length & energy loss.
6. Trial on Pelton wheel.
7. Trial on Francis turbine.
8. Trial on Reciprocating pump.
9. Trial on Centrifugal pump.
10. Trial on Hydraulic Ram.
11. Study of Hot wire Anemometer, Laser Doppler Anemometer.

**5CE08: BUILDING PLANNING AND CAD –Lab**

Creating drawing of following, manually & by Auto CAD/Felix CAD and printouts to be submitted along with 10 free hand sketches on quarter of the imperial size sheet.

1. Developing working drawing of single storied residential building from the given line plan.
2. Preparing line plan of residential building from the given data. Developing submission drawing of the above as per requirement of the plan sanctioning authority. (Separate data should be given to every student).
3. Developing working drawing of multistoried framed structures (Apartment building) from given line plan.
4. Developing line plans of public building from the given data (minimum 2 line plans)
5. Free hand sketches: development of free hand sketches of components of building and elevation features of building such as balconies, chajjas, etc.

**5CE09: SURVEYING -II - Lab****PRACTICALS –**

Minimum 8 practicals from the list mentioned below shall be performed by each student and observations, calculation and relevant work shall be submitted as a sessional work.

Practical examination shall consist of field exercise and vivavoce examination based on the above syllabus & practicals.

**LIST OF EXPERIMENTS :**

1. Ranging circular curve by offsets from Long Chord.
2. Ranging circular curve by offset from tangents.
3. Ranging circular curve by offset from chord produced.
4. Ranging circular curve by single theodolite.
5. Ranging circular curve by double theodolite.
6. Ranging of transition curve.

7. Finding out tachometric constants.
8. Finding out height & distances by tachometry.
9. Practical on Stereoscope.
10. Location of true meridian at the given point.
11. Triangulation by satellite station.
12. Base line measurement.
13. Triangulation
14. Finding out Latitude and Longitude of a place.
15. To find horizontal distance and difference in elevation between two points by using Total station.

#### **5CE010: COMMUNICATION SKILL - Lab**

- 1) Interactive Language Laboratory.
- 2) Group Discussion
- 3) Submission of Technical Report.
- 4) Mock Interview.

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#### **6CE01: NUMERICAL METHODS AND COMPUTER PROGRAMMING SECTION - A**

- Unit-I :** 1. Basic grammar of FORTRAN, use of library functions  
2. FORTRAN coding sheet, input output statements, format for input output statement, flowchart  
3. File input output
- Unit-II :** 1. Control statements: GO TO, computed GO TO, Assigned GO TO, arithmetic IF, logical IF, block IF, DO statement, implied DO loop  
2. Type declaration statement, DIMENSION statement, subscripted variables, DATA statement
- Unit-III :** 1. Sub – programs: Statement function, function sub – program, subroutine sub program. Dummy and actual arguments.  
2. COMMON statement, labeled and blank COMMON,

#### **SECTION-B**

Computer Programming using FORTRAN 77

- Unit-IV:** 1. Matrix operations such as:
- a. Addition and subtraction
  - b. Multiplication
  - c. Transpose
  - d. Testing summary etc.

2. Fourth order, Runge - Kutta method for solution of first order, second order differential equations and two simultaneous equations.

- Unit-V :** 1. Solution of quadratic equation  
2. Numerical integral using Trapezoidal and Simpson rule  
3. Finding root of equation  $f(x) = 0$  by Newton -Raphson, Regula -Falsi and Bisection method.

- Unit VI :** 1. Centre of gravity, moment of inertia & radius of gyration of Tee section.  
2. Bending moment and shear force ordinates for simply supported beam subjected to point and uniformly distributed load only.  
3. Design of singly reinforced beam by limit state method.  
4. Determination of coefficient of permeability in parallel and perpendicular direction of bedding plane  
5. Reduce level by height of instrument method.  
6. Determination of Chezy's constant.

#### **BOOKS RECOMMENDED:**

1. Rajaraman, Computer Programming in FORTRAN
2. Schaum Series, FORTRAN Programming.

#### **6CE02: STRUCTURAL DESIGN-I**

(Steel structures by Limit State method using IS 800: 2007)

#### **Section - A**

- Unit I:** 1. Introduction to WSM, LSM & plastic analysis.  
2. Design of bolted & welded connections subjected to axial loading.
- Unit II:** 1. Design of compression & tension member.  
2. Design of Industrial shed

#### **Section - B**

- Unit III:** 1. Design of simple & compound columns for axial & eccentric loading.  
2. Design of column bases subjected to axial load & moment, gusseted base & solid slab base.
- Unit IV:** 1. Design of simple & compound Beams.  
2. Design of welded Plate girder.

#### **BOOKS RECOMMENDED:**

1. Duggal, S. K., Design of Steel Structures, Tata McGraw Hill Pub. Company Ltd.
2. N. Subramanyam, Design of Steel Structures, Oxford University Press, 2008.

3. Shah & Karve, Design of steel structures.
4. Sheyakar, Design of steel structure.
5. Bhavikatti, Design of steel structure

**6CE03: WATER RESOURCES ENGINEERING – I**  
**SECTION – A**

**Unit-I:** Engineering Hydrology: Definition and its importance, Hydrological Cycle, Hydrologic equation, Precipitation: Forms, Types, Factors affecting, Measurement, Rain gauge Network, Estimation of Missing data, Consistency of data, Mean Areal Precipitation, Brief introduction of Intensity-duration-Frequency relationship and Artificial rain.

**Unit II :** Evaporation: Process, factors affecting, measurement and estimation, control of evaporation. Evapotranspiration: Factors affecting, measurement, and estimation Infiltration: Process, factors affecting, measurement, Infiltration indices. Run-off: Factors affecting, estimation of runoff, Rainfall- Runoff correlation.

**Unit-III:** Floods: Flood classification, importance, estimation of flood, flood control techniques, Brief description of flood routing. Hydrographs: Typical flood hydrograph, base flow separation, Unit hydrograph, S-curve hydrograph.

**SECTION-B**

**Unit IV:** Irrigation Engineering: Necessity and advantages of irrigation, suitability of soils for different crops, standards for irrigation water. Minor Irrigation Works: Necessity and general layout of Bandhara and percolation Tank. Lift Irrigation: Necessity and general layout, main components

**Unit-V:** Crop Water Requirements: Principal Indian crop seasons and water requirements for different crops, Duty and Delta, Consumptive use of water and its estimation, Irrigation efficiency. Irrigation methods: Comparative study of different irrigation methods with special emphasis on sprinkler and drip irrigation.

**Unit VI:** Ground water: Aquifer parameters, Well hydraulics for steady flow condition, safe yield and yield tests. Water Harvesting: Definition, Need for water harvesting, water harvesting potentially, elements of typical water harvesting system, Methods of water harvesting, cost of water harvesting,

**BOOKS RECOMMENDED :**

**Hydrology**

- 1) Sharma R.K. : Hydrology & Water Resources Engg.
- 2) Raghunath H.M. : Hydrology, Wiley Eastern Ltd., New Delhi.

- 3) Dr.Reddy Jayarami P. : Hydrology, Laxmi Pub., Delhi.
- 4) Subramanya S. : Hydrology, Tata McGraw Hill.

**6CE04: TRANSPORTATION ENGINEERING - II**  
**SECTION – A**

**Unit-I :** RAILWAY: Railway transportation, classification Railway surveying, track standard terminology, track sections in embankment & cutting, high speed trains. Traction and tractive resistance, hauling capacity and tractive effort of locomotives, different types of traction.

**Unit-II:** Permanent way: requirement, gauges, coning of wheels, components of permanent way, Rail types and functions, defects in Rails, Rail joints, Sleeper density, Rail fixtures & fastening. Geometric design of railway track, gauge, gradients, speed, superelevation, cant deficiency, negative superelevation, grade compensation, curves, Railway accidents and causes.

**Unit-III:** Points and crossing Left & right hand turnouts, design calculations for turnout & cross over, types of Track junction, long welded rails. Station and yards : types, function, facilities & equipment. Railway signalling and interlocking: objects, classification & types of signals, control & movement of trains.

**SECTION - B**

**Unit-IV:** AIRPORT: Development of air transportation in India, Agencies controlling national & international aviation, Various surveys to be conducted, airport site selection, Airport drainage, Aeroplane component parts, Aircraft characteristics. Airport obstructions: Zoning laws, imaginary surfaces approach and turning zone Runway and Taxiway design: orientation of runway, wind rose diagram, basic runway length and corrections, runway geometric design standards.

**Unit-V:** Airport layout, Terminal area, unit terminal concept, Apron, Apron layout, Aircraft parking & parking system. Visual aids, Airport parking & lighting of runway, taxiway and other areas. Airport traffic control, need of control aids, instrumental landing systems, accidents in the air.

**Unit-VI:** TUNNELS: Tunnels necessity, types, tunnel economics, tunnel alignment, tunneling methods in soft soil & hard rock. Needle beam method, drift method. Size and shape of tunnels, Tunnel lining, drainage, ventilation & lighting of tunnels.

**BOOKS RECOMMENDED :**

- 1) Saxena & Arora : Railway Engineering.
- 2) Agrawal M.M. : Railway Engineering.
- 3) Khanna S.K., Arora M.G., Jain S.S. : Airport Planning & Design,
- 4) Srinivasan : Tunnel Engineering.

**6FECE05 : FREE ELECTIVE-II  
(i) DISASTER MANAGEMENT  
SECTION – A**

- Unit I:** What is disaster, types, damage caused, pre-disaster preparedness, post-disaster preparedness, early warning strategies, National disaster management guidelines, role of NGO'S in disaster management.
- Unit II:** Principles of emergency management, crisis management, International organizations such as Red cross, United Nations, European Union, Indian organizations, Natural hazards in coastal states in India, what is Tsunami, its characteristics.
- Unit III:** Monsoon in India, its calculations, flood hazard in India. Regions of country prone to floods, flash floods, damages caused due to floods, Do's and Don'ts in Earthquake.

**SECTION - B**

- Unit IV:** Application of remote sensing in disaster management, flood forecasting and warning in India, coordination of central water commission and Indian meteorological department, action plan for flood forecasting and warning.
- Unit V :** Disaster risk reduction programme, institutional strengthening and capacity building for DRR by Central Govt., State disaster management authority, its functions human resource support required at SDMA, need of psychosocial support and mental health in disasters.
- Unit VI :** Training of human resource in disaster risk reduction planning at state level, awareness among people, key responsibility of engineers in disaster reduction techniques, medical preparedness aspect of disaster, plan to counter, threats to water supply.

**Books Recommended;**

- 1) Cuny, Fred C; Disasters and management, oxford Uni. Press.
- 2) Alexander, David; Principles of emergency planning and management, Terra publishing, ISBN 1-903544-10-6
- 3) National Disaster Management Authority, Govt. of India, Report.

- 4) A.S. Arya Action Plan For Earthquake, Disaster, Mitigation in V.K. Sharma (Ed)  
Disaster Management IIPA Publication New Delhi, 1994

**6FECE05 : FREE ELECTIVE-II  
(ii) ENVIRONMENTAL MANAGEMENT  
SECTION – A**

- Unit I :** The nature, scope and components of environmental management.  
Environmental impact analysis- need and importance, step involved methods of EIA, public participation and communication.
- Unit II:** Environmental policy analysis- micro level and macro level, methods of policy analysis, steps involved. : Operational methods, quantitative methods, statical analysis public policy analysis resource allocation, environmental economics etc.
- Unit III:** Environmental management plan (EMP): components of Environmental Management Plan, Preparation of Environmental Management Plan

**SECTION – B**

- Unit IV:** Environmental Legislation and Acts: Water (prevention and control of pollution) Act 1974, Air (prevention and control of pollution) Act 1981, Environmental protection Act (EPA) 1986, Hazardous waste rules 1989, Factory Act 1984 amendments in 1987, Environmental Management System: ISO 14000(EMS) Environmental Audits: methods, components and preparation.
- Unit V:** Various agencies for Environmental Managements in India: Ministry of environment and forest, central pollution control boards, state pollution control boards, local bodies, - their scopes, organizational and functional issues, their working etc.
- Unit VI:** Basics of Data Base Management System (DBMS), Geographic Information System (GIS) and remote sensing in Environmental Management.  
Information of software for EIA

**Books Recommended :**

- 1) Environmental Impact Analysis- a decision Making Tool: By R K Jain
- 2) Theory and Practice of Environmental Impact Assessment: By Abbasi AND Ramesh

- 3) Environmental Impact Assessment: By Shrivastava
- 4) Environmental laws and policy in India, Armin Rozenecaranz, Sham Diwan Marhta L. Nobel, Tripathi publication.
- 5) Environmental Legislation: V Krishnamurthi

**6CE06: ESTIMATING AND COSTING  
SECTION – A**

**Unit-I :** General: Importance of the subject, purpose of quantity estimates, Modes of measurement and units of measurement as IS1200. Methods of cost estimating in general, various methods of stage-I (approximate) estimates.

Specification: Purpose and principles of specification writing, types of specification writing and developing detailed specification of a few items related to building, Irrigation Work, Road work. Problem on Four rooms for measurement only

**Unit-II :** Cost Building-up: purpose and principles, importance of Schedule of Rates in cost estimates, factors affecting analysis of rates. Fixed, variable prime and supplementary cost, overhead costs and its allocation. Recommendations from N.B.O. for Task work, No. of workman etc., Schedule of rates, market rate analysis of some specific items including transportation cost. Workout quantities of various materials required for construction, such as cement, steel, bricks, aggregates, timber.

**Unit-III:** Cost & Quantity Estimate: Methods of detailed estimates, forms used, detailed estimates of Civil Engineering works, Building, Quantity estimates:

**SECTION – B**

**Unit-IV:** Earth work estimates in Roads including hill road. Earthwork calculations for earthen dam.

**Unit-V :** Valuation - Purpose of valuation, value and cost, market value, potential value, sentimental value, scrap value, etc. Real estate, Guilt edged security. Net & gross return, tenure of land, free hold & lease hold property. Sinking fund, Depreciation, capitalized value, annualized value, of a old building.

**Unit-VI:** Organisation for construction industry specific to Govt. organisation. P.W.D.Organisation, Site administration, Labour contracts, BOT. Role of Govt.deptt. as a construction agency, Arranging Works: Methods of carrying out works, Arranging contract work, Tender Notices, acceptance of tender, essentials of contracts, types of contracts, contract documents,

Indian contract law and Engineering contracts, land acquisition Act, Legal aspects of various contract provision. Cost accounting, various methods; classification of cost, direct & indirect charges, distribution of overheads, MAS account, issue rate of store account.

**BOOKS RECOMMENDED:**

1. R.H.Namavati. : Estimating and Valuation
2. D.N.Datta : Estimating & Costing – Datta Lucknow.
3. Vazirani: C.E.Estimating & Costing, Chandola Khanna Publisher Delhi.
4. B.S.Patil: Estimating Costing – Orient Longmans.
5. P.W. & H.Deptt. Govt. of Maharashtra: Standard Specification
6. Namavati: Valuation
7. Rangawala: Valuation Charotar Book Stall
8. Dhanpat Rai: Text book of Estimates Costing – Anand & Sons, Delhi.
9. B.C.Chakraborty: Principles of Estimation & Costing.
10. Indian Contract Act.

**6CE07 : NUMERICAL METHODS AND  
COMPUTER PROGRAMMING -Lab**

**PRACTICALS:**

Preparation and execution of at least eight computer programs using FORTRAN. A journal/report on experiments conducted shall be submitted by each student. Practical examination shall be viva-voce based on above practical and the syllabus of the course.

**6CE08 : STRUCTURAL DESIGN-I – Lab**

**PRACTICALS:**

1. Candidates are required to prepare at least two designs of steel structures based on theoretical course detailed workings are necessary.
2. A compulsory site visit for studying the various aspect and prepare a report. An Journal/report on experiments conducted shall be submitted by each student. Practical examination shall be viva-voce based on above practical and the syllabus of the course.

**6CE09: ESTIMATING AND COSTING –Lab**

**PRACTICALS –**

The candidates submit the following:

- 1) i) Detailed estimate of a single story building with minimum four room with a flat roof (Given problem.)
- ii) Detailed estimate of road of minimum 1 KM length with Hot mix coat.

- iii) Detailed estimate of any two of the following.
    - a) R.C.C. Frame structure Residential building.
    - b) Culvert
    - c) Septic tank for a colony.
  - 2. Specification for 10 items as below.  
 Building works 6 Items.  
 Road Work 2 Items.  
 Irrigation work 2 Items.
  - 3. Analysis of 8 Items.
  - 4. Valuation of building, existing Building should be taken for valuation work.
  - 5. Submission of one working drawing by actual (field visit) visit to the construction site & its estimate.
  - 6. Tender documents for the Building in problem No. 1
    - a) Tender Notice.
    - b) Tender.
    - c) Schedule A and Schedule B.
    - d) Conditions of contracts regarding time, labour payment, damages.
  - 7. Use of Computer software for detailed estimate of building.
  - 8. Writing specification for any item.
- NOTE:-** Practical Examination shall consists of viva-voce and a test based on syllabus and sessional work.

#### **6CE10: MINOR PROJECT – Lab**

Any one Group Project in details.

- 1) Irrigation Project
- 2) Rehabilitation of Village / Town
- 3) Water Supply Project
- 4) Sewerage System
- 5) Bridge on River

Students should conduct a detailed survey in a seven day camp.  
 Data Analysis, Design & Submit Report & Drawing sheets.

## **SYLLABUS PRESCRIBED FOR BACHELOR OF ENGINEERING MECHANICAL ENGINEERING SEMESTER PATTERN (CREDIT GRADE SYSTEM)**

### **FIFTH : SEMESTER**

#### **5ME01 PRODUCTION TECHNOLOGY**

##### **Section - A**

**UNIT I :** Concept of quality and quality control, quality of design and quality of conformance, Quality characteristics, Cost of quality & Value of quality, Specification of quality, quality control & inspection.

Concept of TQM & Quality assurance,  
 Concept of variation, variable and attribute data, Frequency distribution, Measures of Central tendency- Mean, mode & median, Measures of dispersion. -Range, std. deviation & variance. (8)

**UNIT II :** Concept of universe and population, Normal distribution curve; Control charts for variables, process capability, Control charts for attributes; comparison between variable charts and attribute charts; precision & accuracy, Sampling plans, Operating Characteristic curve, Quality circle. (8)

**UNIT III :** Basic principles of work study : definition, method study, introduction, objective, procedure, process charts, flow process charts, operation process chart, principles of motion economy, work place layout, multiple activity chart, two handed process chart, simo chat. Work measurement : definition, techniques, time study, rating system, allowances, std, time estimation, PMTS, MTM. (7)

##### **Section - B**

**UNIT IV :** Standards of measurements: line standards, end standard, wave length standard. Limits, fits and gauges : terminology of limits, Fits and gauges, concept of interchangeability, allowance tolerance, Indian Standard Specification for limits, fits and gauges, B.S. System. Limit gauging - design of Go, No Go gauges. (8)

**UNIT V :** Linear measurement: various comparators such as mechanical, electrical, optical, pneumatic comparators, their principle, operations and applications.

Angular measurements: vernier, optical, bevel protractor universal bevel protector, Sine bar level clinometers, taper gauges. Thread measurement: screw thread limit and fit limits gauging of screw threads (8)

**UNIT VI :** Gear measurement : alignment error, master gear, Parkinson tester.

Study and use of optical dividing head, auto collimator, tool makers microscope.

Interferometry, flatnesstesting, squareness testing. Surface texture testing.

Coordinate measuring machine- types, role and application.

(7)

**Books Recommended:**

**Text Books:**

1. Engineering Metrology – R.K.Jain - Khanna Publishers.
2. Statistical Quality Control- M. Mahajan – Dhanpatrai & Co. Pvt. Ltd.
3. Work Study, ILO

**Reference Books:**

1. Quality Control - By Juran - Mc. Graw Hill Pub. Company.
2. Statistical Quality Control- By Grant E.L. – R.S.L.Leavgen Worth- Mc. Graw Hill Pub. Company
3. Statistical Quality Control- By Gupta - Dhanpatrai & Com. Pvt. Ltd

**5ME02 HEAT TRANSFER**

**Section - A**

**UNIT -I:** Introduction, heat transfer in engineering, modes of heat transfer, basic laws of heat transfer and their basic equations. Conduction-thermal conductivity and thermal diffusivity effect of phase & temperature on thermal conductivity, one dimensional steady state heat conduction through slab, cylinder & sphere-simple and composite. Combined conduction- convection, overall heat transfer coefficient. General heat conduction differential equation. One dimensional steady state conduction with internal heat generation for infinite slab, wire & cylinder. **(8 Hrs)**

**UNIT II:** Insulations, critical radius of insulation, Conduction through extended surfaces, analysis of a uniform C.S. fin, fin efficiency, fin effectiveness, Biot number. Introduction to unsteady state heat conduction, Newton's law of cooling, lumped heat capacity analysis. **(8 Hrs)**

**UNIT III :**

Radiation- general concepts and definitions, black body & grey body concept. Laws of radiation- Kirchoff's, Plank's, Stefan-Boltzman's, Wien's law. Concept of shape factor, emissivity factor and radiation heat transfer equation. (No numericals). Radiation errors in temperature, measurement, radiation shield.

**(7 Hrs)**

**Section - B**

**UNIT IV:** Forced convection- heat convection, forced and natural convection, boundary layer theory, hydrodynamic & thermal boundary layers, boundary layer thickness. Laminar & turbulent flow over flat plate and through pipes & tubes (only concept, no derivation & analytical treatment). Dimensionless number and their physical significance Reynold, Prandtl, Nusselt, Grashoff number, empirical correlations for forced convection for flow over flat plate, through pipes & tubes & their applications in problem solving. **(8 Hrs)**

**UNIT V:** Free convection- velocity and thermal boundary layers for vertical plate, free convection over vertical cylinder and horizontal plate/cylinder (only concept, no derivation & analytical treatment). Use of empirical correlations in problem solving. Condensation & Boiling - introduction to condensation heat transfer, film & drop condensation. Boiling heat transfer, pool boiling curves. **(7 Hrs)**

**UNIT VI:** Heat exchanger - applications, classification, overall heat transfer coefficient, fouling. L.M.T.D. & E.N.T.U. methods, temperature profiles, selection of heat exchangers. Introduction to working of heat pipe with and without wick. **(7 Hrs)**

**Books Recommended**

**Text Books:-**

1. Heat and Mass Transfer; R.K Rajput; S. Chand, New Delhi
2. Heat and Mass Transfer; V.M. Domkundwar; Dhanpat Rai & Co. Delhi

**Reference Books:-**

1. Heat Transfer; J.P. Holman; McGraw Hill
2. Heat Transfer; P.S. Ghoshdastidar; Oxford University Press, Mumbai
3. Heat Transfer; P.K. Nag; TMH.

**5ME03 MEASUREMENT SYSTEMS**

**Section - A**

**UNIT I :** 1. Generalized Measurement system: Significance of measurement, generalized systems. application of measuring instruments. Types of measuring instruments.  
2. General configuration and functional elements of measuring instruments, types of inputs, various methods of correction for interferences and modifying inputs. **(6 Hrs)**

**UNIT II : General performance Characteristics:-**

1. Static characteristics, different types of errors, combination of component errors in overall systems.
2. Dynamic characteristics : General mathematical model of zero order, first order and second order instruments,



response of first and second order instruments to following inputs step, ramp, impulse and frequency.

(10Hrs)

**UNIT III : Strain Measurement :**

- Types of strain gauges, strain gauge circuits, calibration, Temperature compensation, use of strain gauges on rotating shafts, selection and installation of strain gauges.
- Pressure Measurements:-  
Basic methods of pressure measurement, manometers, Transducers-elastic, gravitational. elastic : draph, strain gauge pressure cell, High pressure measurement Bridgeman type, low pressure Measurement - Mcleod, Krudsen, ionisation, Thermal conductivity gauges. (8 Hrs)

**Section - B**

- UNIT IV:**
- Force Measurement: Various mechanical. Hydraulic, pneumatic and electrical methods.
  - Torque and Power Measurements : Various mechanical, hydraulic & electric methods.
  - Flow Measurements : Construction- Venturi, orifice, Dall tube, Rota meter. Pressure probes- Pitot static tube, yaw tube anemometer, positive displacement flow meters, turbine meter, electro-magnetic flow meter. (8 Hrs)

- UNIT V :**
- Temperature Measurements : Standards, Various temperature measuring devices, Bimetallic strip, liquid in glass thermometer, pressure thermometers, thermo couples, electrical resistance thermometers, Thermistors, radiation Thermometers.
  - Liquid Level Measurements : Various methods such as single float, displacement or force transducers. Pressure sensitivity, bubbler or Page system, capacitance variation type (for both conducting and non conducting type liquids) Resistance variation type, Radioisotope. (8 Hrs)

- UNIT VI:**
- Speed Measurements : Various mechanical type tachometers, electrical types tachometers, stroboscope etc.
  - Vibration Measurements : Seismic, Strain gauge and piezoelectric accelerometers.
  - Displacement measurements : Linear and angular displacement measurements, LVDT, LDR, Capacitive & inductive pick ups. ( 8 Hrs)

**Books Recommended**

**Text Books:-**

- Measurement Systems : - By Erenest O. Doebelins - MC Graw Hill.
- Mechanical Measurement & Control: By D.S.Kumar.

**References Books:-**

- Mechanical Measurements :- By T.G.Beckwith & N.L.Bulk - Addison Werllv.
- Instrumental Measurement & Analysis : By Nakra Choudhari Tata Mc Graw Hill.
- Mechanical Measurement & Instrumentation :By R.K.Rajput,Katsons Books Publications

**SME04 THEORY OF MACHINES-I**

**Section - A**

- UNIT I:**
- Introduction to study of mechanisms, machines, basic definitions, different types of links, kinematic pairs. Grashof's law- class-I and class -II mechanisms. Grubler's criterion, Kutrbach's theory. Inversions of four bar, single slider, double slider mechanisms,.
  - Kinematic analysis of mechanisms:- Transmission angle, Mechanical Advantage, coupler curve and their properties, radius of curvature of coupler curves.. (8 Hrs)

- UNIT II:**
- Velocity analysis:- Relative velocity method, method of equivalent mechanisms, Instantaneous centre of rotation method, body and space centroids,.
  - Acceleration analysis:- Relative acceleration method, analytical method and, Klein's construction for slider crank mechanism. (10 Hrs)

- UNIT III :** Synthesis of Mechanisms:- Introduction to type, number and dimensional synthesis, graphical method of two position, three position and four position synthesis for input output co-ordination, Overlay method, Freudenstien's equation, Blosch's method. (7 Hrs)

**Section - B**

- UNIT IV:** Frictional torque in pivot and collar bearing. Brakes, Clutches, and Dynamometers: types, constructional details, operation & calculation of leading dimensions. (8 Hrs)

- UNIT V:** Special purpose mechanisms:- Steering mechanisms, Geneva wheel mechanism.  
Cams:- Introduction, types of cam & follower, different motions of followers, graphical layout of cam profiles, cam with specified contours. (8 Hrs)

- UNIT VI:** I) Gear :-  
Introduction, terminology, gear tooth profiles, involumetry, interference, spur, gears, spiral gears, and its efficiency,  
II) Gear Trains:- Types of gear trains, speed ratio applications.  
(8 Hrs)

**Books Recommended:**

**Text Books:**

- 1) Theory of Machines, S.S.Ratan, Published by Tata Mc Graw Hill.
- 2) Theory of Machines and Mechanisms, J.E.Shigley, Uicker and Gordon, Published by Oxford University press-New York.
- 3) Theory of Machine, R.S.Khurmi and Gupta J.K., Published by Eurasia Publishing house-N Delhi.

**Reference Books:**

- 1) Theory of Machines, V.P.Singh, Published by Dhanpat Rai-N Delhi.
- 2) Theory of Machines, P.L.Ballaney, Published by Dhanpat Rai and sons-N Delhi.
- 3) Theory of Machines and Mechanisms, Rao J.S. and Gupta K.N., Published by Wiley Eastern-N Delhi.
- 4) Machines and Mechanisms (applied kinematic analysis), David H. Myszka, Published by Pearson Education –Asia.
- 5) Mechanisms Design (analysis and synthesis), Arthur G.Erdman and George N.Sandoor, Published by Prentice Hall Inc.
- 6) Theory of Machines and Mechanisms, Ghosh and Amitabh, Published Affiliated East West Press, N-Delhi.

**5FEME05 FREE ELECTIVE-I  
(1) MANUFACTURING TECHNIQUES**

**Section A**

- Unit I:** Overview of manufacturing: Manufacturing science, Introduction to various activities in manufacturing, Properties and application of common ferrous and non-ferrous metals, Common methods of manufacturing, Selection of manufacturing process, Selection of material. (6Hrs)
- Unit II:** Various Machining operations – Turning, planning, shaper, milling, drilling, boring and grinding process. Introduction to tools and equipments required to perform various operations. (8Hrs)
- Unit III:** Introduction to metal forming and sheet metal process: Forming process- Forging, rolling, extrusion, wire drawing. Sheet metal processes- Forming, bending, drawing, coining, embossing. Cutting process: Punching, blanking, shearing, lancing. (7Hrs)

**Section B**

- Unit IV:** Casting: Steps involved in casting, advantages of casting, pattern, difference between pattern and casting, pattern allowances, material used for patterns, molding sand, sand mould making core, types of cores, defects of castings, melting furnace(Cupola), casting process and its applications. (6Hrs)
- Unit V:** Joining process with its types, advantages and disadvantages of riveting, soldering, brazing. Arc welding, gas welding, resistance welding, friction welding. (6Hrs)
- Unit VI:** Powder metallurgy: Methods of production of metal powder, steps in powder metallurgy, mixing and blending, compaction, sintering and finishing. Plastic part manufacturing: Process of extrusion, injection molding, blow molding, compression molding, transfer molding, advantages and disadvantages. (7Hrs)

**Books Recommended:**

**Text Books:**

1. Manufacturing processes –Workshop practice, R.A. Khan, Ali Hassan, Scitech Pub.
2. Workshop Technology - Hajra Chaudhary, Dhanpat Rai and Sons.

**References:**

1. Processes and materials of manufacture E.P. Degarmo, Prentice Hall of India (PHI)
2. Material and processes in manufacturing Lindberg, Tata McGraw Hill Pub.

**5FEME 05 FREE ELECTIVE - I  
(2) ERGONOMICS  
Section – A**

- Unit I:** Introduction to Ergonomics , Man machine system, brief history of ergonomics, introduction to human anatomy, posture and body mechanics, musculoskeletal problems in seating and standing (8)
- Unit II:** Anthropometry and Work Place Design, Anthropometric data, applying engineering anthropometry to work station design, work place design for standing and seated workers (7)
- Unit III:** Design of Manual Handling Task , Assessment of Work Load, Anatomy and biomechanics of manual handling & design of manual handling task , lifting , lowering and carrying, grasping and pinching, physiology , workload and work capacity. (7)

**Section – B**

- Unit IV :** Environmental Factors, Auditory environment- basic principles, Noise & vibration, measurement of sound, noise

exposure and hearing loss, annoyance & distraction, interference with communication, structure of ear, Thermal environment-basic principle, factors affecting the human comfort, physical work and heat stress, visual environment-basic principle, main factors in visual environment, illumination and color, lighting, glare Whole body vibration , segmental vibration, sources of vibration, discomfort  
(8)

**Unit V:** Design of controls and tools, Design of controls, symbols, labels, visual displays of dynamic information, design and selection of tools (7)

**Unit VI:** Applications of ergonomics in various fields, Human errors, accidents & safety. (7)

### Books recommended

#### Text books –

1. Introduction to Ergonomics by R S Bridger, Edition 1995, Mc Graw Hill International.

#### Reference books –

1. Human Factors in Engineering & Design by Mark S Sanders and Ernest J. Mc Cormick, Seventh Edition, Mc Graw Hill International
2. Ergonomics in manufacturing , Edited by Waldemar Karwowski & Gavriel Salvendy, Engineering Management Press (EMP), Georgia
3. Industrial Ergonomics; M.I. Khan; PHI.

## 5FEME05 FREE ELECTIVE-I (3) PRODUCTION MANAGEMENT

### Section -A

**UNIT I:** Designing products, services and processes; Historical evolution of productions and operations management, new product designs, manufacturing process technology. Flexible manufacturing systems(FMS) and computer integrated manufacturing(CIM), design of services and service processes, tools for product development. Standardization, simplification, specialization, diversification, product analysis.

**UNIT II:** Forecasting & Facility Location: Types of forecasting models, selection of the forecasting model, need for facility location planning, procedures for facility location planning, facility

location planning, facility location models & facility payout planning.

**UNIT III :** Job Design & Capacity Planning: effective job design, production and operations standards, method study, work measurement, capacity measuring , capacity planning modeling, capacity strategies.

### Section -B

**UNIT IV:** Aggregate Planning for Production & Scheduling: Operation planning and scheduling systems, the aggregate planning process, strategies for developing aggregate planning, master scheduling and rough cut capacity planning, aggregate planning for service organizations, loading sequencing, expediting.

**UNIT V :** Inventory Control: Demand and control system characteristics, inventory concepts, costs Modeling, Deterministic inventory models, stochastic inventory models, inventory control application, just-in-time manufacturing.

**UNIT VI:** Quality Management: Quality and quality related costs, quality function deployment(QFD), Taguchi's off-line quality control methods, managerial responsibility in managing for quality products & services. TQM. Failure analysis, bath tub curve, Reliability of system, Maintainability and availability.

### Books Recommended

#### Text Books:

1. Production and operations management- concepts models and Behaviour by Everett E. Adam, Jr., & Ronald J. Ebert (Prentice- Hall of India)
2. Production and operations management – Total Quality and responsiveness by Hamid Noori & Russell Radfort (Mc Graw Hill, Inc.)

#### References Books

1. Industrial engineering & production Management by M. Mahajan (Dhanpat Rai & Co.)
2. Industrial engineering & management by O.P.Khanna(Dhanpat Rai & Co.)
3. Production and Operations Management; J.P. Saxena; McGraw Hill

## 5FEME05 FREE ELECTIVE-I (4) PROJECT MANAGEMENT

### Section -A

**UNIT I :** Concepts of Project & Project Selection : Project & development, concept of a project, external causes of delay, Internal constraints, criteria for project selection models,

Types of project selection models, Analysis under high uncertainty, project proposals.

**UNIT II:** Project organization and planning: organizational form, strategic variables, need for planning, project coordination, negotiation and conflict resolution.

**UNIT III:** Budgeting and Cost Estimation: estimating project budgets, improving the process of cost estimation, Life-cycle-costing, project cost reduction methods.

#### **Section -B**

**UNIT IV:** Scheduling and resource allocation ; Network Techniques CPM and PERT, Gantt Charts, resource constraints, resource loading, resource leveling, integrated resource management.

**UNIT V:** Project Control: monitoring and information systems MIS, purposes of control, types of control processes, project cost overruns and cost control, project audit.

**UNIT VI:** Issues in project Management: Multicultural, issues, project cost escalation, conflict zones in project management, appraisal processes, concepts and techniques, managing project resources flow, project feasibility study.

#### **Text Books:**

1. Text Book of Project Management by P. Gopalkrishnan & VE Rama Moorthy (MacMillan India Ltd)
2. Project Management – A Managerial Approach by Jack R. Meredith & Samuel J. Mantel, Jr.(John Wiley & Sons Inc.)

#### **Reference Books:**

1. Project Management by Clifford F. Gray/Erik W. Larson (Mc Graw Hill).
2. Project Management by Prassana Chandra.

#### **SME06 PRODUCTION TECHNOLOGY-LAB.**

**Practicals :** At least six from the below list.

#### **Minimum Six experiments from the following list:**

1. Determination of Linear/Angular dimensions of a given specimen/part using Precision/Non-Precision Measuring instruments.
2. Precision Angular Measurement using Sine Bar/Sine Centre, Autocollimator/Angle Dekkor.
3. Measurement of Gear Tooth Thickness by Gear Tooth Vernier Caliper/Constant Chord/Span Micrometer.
4. Measurement of Circularity/Roundness of a given specimen.
5. Measurement of Screw Thread Element by Floating Carriage Micrometer.
6. Testing of Surfaces by using Optical Flat.

7. Measurements of various angles of single point cutting tool by using Profile Projector and Tool Maker's Microscope.
8. Preparation of X and R chart for the given lot of sample.
9. Preparation of process chart.

#### **Practical Examination :-**

The practical examination shall consist of oral on term work and syllabus taken jointly by Internal and External examiner.

#### **SME07 HEAT TRANSFER-LAB.**

#### **List of Practical (Any six of the following):-**

1. Determination of thermal conductivity of a metal bar.
2. Determination of thermal conductivity of insulating powder.
3. Study of heat transfer through composite wall.
4. Study of heat transfer through composite cylinders.
5. Determination of fin efficiency.
6. Verification of Stefan-Boltzman's law.
7. Determination of emissivity of grey body.
8. Determination of heat transfer coefficient for forced convection.
9. Determination of heat transfer coefficient for natural convection.
10. Study of pool & nucleate boiling.
11. Trial on double pipe heat exchanger.
12. Determination of efficiency of cross flow heat exchanger.
13. To write a computer program for conduction heat transfer problem.

**Practical Examination:-** The practical examination shall consist of oral on the term work and syllabus.

#### **SME08 MEASUREMENT SYSTEMS-LAB.**

#### **List Of Practical :**

Atleast of eight practicals from the following list.

1. Measurement of strain using strain gauges.
2. Calibration of pressure gauge with pressure gauge tester.
3. Measurement of linear displacement by LDR and inductive pick-up transducers.
4. Performance of capacitance transducer as a angular displacement measuring device.
5. Performance of inductive Transducers.
6. Flow measurement.
7. Speed measurement by a stroboscope.
8. Speed measurement by magnetic pick up or phot electric pick up tachometer.
9. Pressure measurement by strains gauge type transducer.
10. Vibration measurement.
11. Liquid level measurement.

12. Temperature measurement.

The practical examination shall consist of viva-voce on the above syllabus & practical work.

#### **5ME09 THEORY OF MACHINES - I - LAB.**

**PRACTICALS:-** At least eight practicals from the below list shall be performed.

1. Study of inversion of four bar mechanism.
2. Study of inversion of slider crank mechanism.
3. Study of inversion of double slider crank mechanism.
4. Study of velocity analysis by relative velocity method/ pole technique.(2 Prob)
5. Study of acceleration analysis by relative acc. method. (2 Prob)
6. Study of brakes.
7. Study of clutches.
8. Study of dynamometer.
9. Study of Graphical layout of cam profile. (3 Prob.)
10. Study of gear trains
11. Problem in position synthesis.
12. Problem in input/output coordination
13. Computer aided synthesis of four bar mechanism.

The practical examination shall consist of viva-voce on the above syllabus & practical work.

#### **5ME10 COMPUTER SOFTWARE APPLICATIONS -I – LAB.**

1. 2D & 3D CAD modeling methodology using packages like AutoCAD, CATIA, Pro-E, Solidedge, Unigraphics, etc..
2. Creation of 2D Drawing (Sketching module) of any three mechanical machine component using any modeling /drafting software.
3. Creation of 3D drawing (part Module) of any three mechanical machine parts using any modeling software.
4. Creation of an assembly using (assembly module) various machine 3D parts using any modeling software.
5. Creation of 3D detailed part for any sheet metal components using 3D Product modeling software.
6. Creation of any one mechanism/animation using any modeling software.

At least five practicals from the above list should be performed.

#### **Practical Examination:-**

It shall consist of viva-voce based on term work and syllabus to be examined by internal and external examiner.

### **SEMESTER : SIXTH 6ME01 FLUID POWER-II**

#### **Section - A**

- Unit I :** 1. Prime Movers :- Theory of impulse and reaction machines. Pelton, Francis and Kaplan turbines, their construction, classification, analysis, characteristics and governing, draft tube, unit quantities. (8)
- Unit II :** Centrifugal pumps :- Basic Theory, classification, construction, operation, characteristics, multistage, NPSH and cavitations in pumps. (7)
- Unit III:** 1. Axial flow pump :- Basic theory, construction, operation, and characteristics.  
2. Other water lifting devices :-  
(a) Air lift pump.  
(b) Jet Pump.  
(c) Hydraulic Ram.  
3. Computational Fluid Dynamics (CFD): Basic Definition, Applications of CFD in the area of research & Industry. Comparison of Experimental Fluid Dynamics and Computational Fluid Dynamics, Importance of Governing Equations and the physical meaning of the involved terms. Equation of continuity, equation of motion & energy balance equation in Cartesian & cylindrical polar coordinates. (10)

#### **Section - B**

- Unit IV :** Positive displacement Pumps :-1. Reciprocating Pumps :- Basic theory, types, construction, installation and characteristics. 2. Rotary Pumps :- Basic theory, types, construction and variable delivery pumps. (9)
- Unit V :** Compressible fluid flow :- Perfect gas relationship, speed of sound wave, mach number, Isothermal and isotropic flows, shock waves, fanno and Rayleigh lines. (8)
- Unit VI :** 1. Hydrostatic systems, their function, components and application such as Hydraulic press, lift, crane and fluid drive for machine tools. Intensifier and accumulator  
2. Hydrokinetic systems : Fluid couplings and torque converter. (8)

#### **Books Recommended :-**

##### **Text Books:-**

1. CSP Ojha, R. Berndtsson, Fluid mechanics and machinery; Oxford university.
2. Bansal R.K., Fluid mechanics and fluid machines; Laxmi publications.

**Reference Books:-**

1. Jagdish Lal, Hydraulic machines; Metropolitan Book Co. Pvt. Ltd.
2. Dr. Mody & Seth, Hydraulics and Fluid Mechanics; Standard house book.
3. Sen gupta, Computational fluid dynamics; Pearson Publishers.
4. Sameer sheikh, Iliyas Khan, Treaties on Hydraulics; Pneumatics, R.K. Publication.

**6ME02 COMPUTER SOFTWARE APPLICATIONS****Section -A**

**Unit I : Introduction to data base management system (DBMS):** Database system application, purpose of database systems, view of data, database languages, relational databases, database design, object based and semi structured databases, data storage and querying, transaction management, data mining and analysis, database architecture, database users and administrators. **(6 Hrs)**

**Unit II : Relational Databases:** Structure of relational database, Fundamental relational algebra operation, Additional relational algebra operation, extended relational algebra operation, Null values, Modification of the database. **(6 Hrs)**

**Unit III : Database design and the E-R model:** Overview of the database process, The entity- relational model, Constraints, Entity-relationship diagrams, Entity- relationship design issues, Weak entity sets, Extended E-R features, Database design of banking enterprise, reduction to relational schemas, other aspects of database design the unified modeling languages. **(8 Hrs)**

**Section-B**

**Unit IV : Structured Query Language(SQL) :** Introduction, data definition, basic structure of SQL queries, set operations, Aggregate functions, null values, nested sub queries, complex queries, view, modification of the database, joined relations, SQL data types and schemas, integrity constraints. **(8 Hrs)**

**Unit V : Relational Database design:** Features of good relational design, atomic domains and first normal forms, decomposition using functional dependencies, functional-dependency theory, decomposition using functional dependencies, decomposition using multi valued dependencies, more normal forms, database design process, modeling temporal data. **(8 Hrs)**

**Unit VI : Modeling and Simulation :** Model, Types of model, advantages of modeling, need of system modeling, system approach to modeling, Introduction to simulation, modeling of simulation,

environment, component of system, steps in simulation, advantages and disadvantages of simulation, simulation Languages and packages. **(6 Hrs)**

**Books Recommended:****Text Books:**

1. Database system concepts –A. Silberschatz, H. Korth, Mc-Graw-Hill, 5<sup>th</sup> Edition.
2. System Simulation –G. Gordon, Prentis Hall international publication
3. Database Management systems; Raghu Ramkrishnan, Johannes Gehrke; McGra Hill International

**Reference Books:**

1. An Introduction to Database system –C. J. Date, Addison Wesley publication
2. System Simulation with digital computer – Narsingh Deo, Prentis Hall international

**6ME03 CONTROL SYSTEM ENGINEERING****Section - A**

**Unit I:** Introduction system concept, open & closed loop systems, Mathematical models of physical systems, transfer functions. Block diagrams reduction and signal flow graphs.

**Unit II :** Basic control actions and Industrial controllers :-Classification of industrial automatic controllers, control actions, proportional controllers, obtaining derivative and integral control action, effects of integral and derivative control action on systems performance.

**Unit III :** Transient Response Analysis :- Introduction Std. Test signals, steady state response of first and second order systems for step, ramp and impulse input, transient response specifications, steady state error & error constants.

**Section - B**

**Unit IV:** Concept stability, necessary condition for stability, Rouths stability criterion, Root locus concept, construction of Root loci, systems with transposition lag.

**Unit V :** Frequency Response methods :-Introduction, concept of Bode diagrams.

**Unit VI :** Study of important automatic speed control systems in machine tools, Prime movers, system generators, etc. Analysis of performance characteristics.

**BOOKS RECOMMENDED:-****TEXT BOOKS :**

1. Modern Control System by Richard C. Dorf, Robert H. Bishop, 9<sup>th</sup> Edition 2007
2. Automatic Control Engineering by F. H. Ravan Mc-Graw-Hill.

**REFERENCE BOOKS:**

- 1) Modern Control Engg. - by Katsuhiko Ogata, PHI, 4<sup>th</sup> Edition 2006.
- 2) Automatic Control Engg. - by Kuo B.C. & F. Golnaraghi, 10<sup>th</sup> edition 2008
- 3) Control System Engg. - by Nagrath & Gopal, 5<sup>th</sup> Edition 2006

**6ME04 THEORY OF MACHINES-II****Section – A**

- UNIT I :**
1. Static equilibrium, superstition principle, Static force analysis applied to plane motion mechanisms, virtual work method, static force analysis without and with friction.
  2. Theory of hydrodynamic lubrication, boundary lubrication, film lubrication, rolling friction, performance of bearing. **(9 Hrs)**

- UNIT II :**
1. D'Alemberts Principle. Engine force analysis-piston effort, thrust along connecting rod, side of cylinder, on the bearings, crank effort and turning moment on the crank shaft.
  2. Dynamic equivalent system of connecting rod. Inertia of the connecting rod. Inertia force in reciprocating engines (graphical method).
  3. Turning moment diagrams for two stroke, four stroke and multi cylinder engines, fluctuations of speed & energy, Flywheel requirements. **(8 Hrs)**

- UNIT III :**
1. Space mechanism:- Gyroscope, gyroscopic effect as applied to ship, aeroplane, 4 wheeler, 2 wheeler, universal joint.
  2. Vehical dynamics :- Coefficient of adhesion, resistance to vehicle motion, relative drive effectiveness, braking of vehicles. **(7 Hrs)**

**Section - B**

- UNIT IV :**
- Concept and basic terms of vibratory motions, types of vibrations, basic features or elements of vibrating systems, degree of freedom in mechanical vibratory system.
1. Longitudinal vibrations- Natural frequency of free longitudinal vibrations by equilibrium, energy and

- Rayleigh method. Effect of inertia constraint in longitudinal vibrations. Damped vibrations with mass, spring and dash pot. Definitions of logarithmic decrement, magnification factor, transmissibility, vibration isolation.
2. Transverse vibrations- natural frequency of free transverse vibrations. Effect of inertia constraints in transverse vibrations. Natural frequency of free transverse vibrations due to point load and uniform distributed load acting over a simply supported shaft. Frequency of free transverse vibrations of a shaft subject to a number of point loads by energy and Dunkerley's method **(9 Hrs)**

- UNIT V :-**
1. Torsional vibration, single rotor systems, Two Rotor system, three rotor system, geared systems, Graphical method for multi rotor system.
  2. Whirling of shaft & critical speeds. **(6 Hrs)**

- UNIT VI :**
- Balancing of Machinery:- Static, & dynamic unbalance, balancing of rotating masses in same and different transverse planes, Balancing of single cylinder, multi-cylinder V and radial engines. Partial balancing of reciprocating masses. Balancing of linkages & machine. **(9 Hrs)**

**Books Recommended:****Text Books:**

- 1) Theory of Machines, S.S.Ratan, Published by Tata Mc Graw Hill.
- 2) Theory of Machines and Mechanisms, J.E.Shigley, Uicker and Gordon, Published by Oxford University press-New York.
- 3) Theory of Machine, R.S.Khurmi and Gupta J.K., Published by Eurasia Publishing house-N Delhi.

**Reference Books:**

- 1) Theory of Machines, V.P.Singh, Published by Dhanpat Rai-N Delhi.
- 2) Theory of Machines, P.L.Ballaney, Published by Dhanpat Rai and sons-N Delhi.
- 3) Theory of Machines and Mechanisms, Rao J.S. and Gupta K.N., Published by Wiley Eastern-N Delhi.
- 4) Mechanisms Design (analysis and synthesis), Arthur G.Erdman and George N.Sandoor, Published by Prentice Hall Inc.
- 5) Theory of Machines and Mechanisms, Ghosh and Amitabh, Published Affiliated East West Press N-Delhi.

**6FEME05 FREE ELECTIVE-II**  
**(1) AUTOMOBILE ENGINEERING**

**SECTION - A**

**UNIT I:** Classification of automobiles, chassis types, Power Unit-Functions, basic working of SI and CI engines, engine parts-types, construction and functions, Multiple cylinder engines, Firing order **(7 Hrs)**

**UNIT II:** Fuel feed systems- fuel feed systems for petrol and diesel engines, Fuel pumps, fuel filters, Air filters, Basic principles of MPFI and CRDI. Multipoint Fuel Injection Systems (MPFI), Common Rail Diesel Injection Systems(CRDI). Cooling system: purpose, types of cooling system, liquid cooling system-water jacket and ports, water pump and radiators, by pass recirculation system, temperature indicator, antifreeze mixtures. **(7 Hrs)**

**UNIT III:** The electrical system. Battery Capacity, standard capacity ratings, starter motor drive-Bendix drive. Ignition system:- Battery coil ignition system, Electronic ignition system **(7 Hrs)**

**SECTION - B**

**UNIT IV: Transmission system:-** Layout, single plate friction clutch and multiplate clutch, clutch troubles and remedies. Gear Boxes:- Sliding mesh, constant mesh gear box, Propeller shaft, Hotchkiss drive, torque tube drive, differential. **(8 Hrs)**

**UNIT V: Braking system:** Mechanical, hydraulic brakes, power brakes, and vacuum brakes Steering system:- Function, types of linkages, steering gears, steering gear ratio, wheel balancing, wheel alignment, camber, castor, king pin inclination, toe-in & toe-out & their effects, Introduction to power steering. **(7 Hrs)**

**UNIT VI: Suspensions :** Rigid axle and independent suspension system, shock absorbers. Auto lubrication :- Types of lubricants, their tests and ratings, multi viscosity oils. Engine lubrication:- types of lubricating systems, full pressure system, dry sump system, oil pump, crankcase ventilation. **(6 Hrs)**

**Books Recommended**

**Text Books:-**

1. Automobile Engineering- Vol. I & II; Kirpal Singh; Standard Publishers Distributors
2. Automobile Engineering; R.K. Rajput; Laxmi Publications, New Delhi

**Reference Books:-**

1. Automotive Mechanics; Crouse & Anglin; TMH.
2. Automotive Mechanics; J.Heitner; East West Press
3. Automotive Mechanics; S. Srinivasan; TMH.

**6FEME05 FREE ELECTIVE-II**  
**(2) NON-CONVENTIONAL ENERGY SYSTEMS**

**Section - A**

**UNIT I: Introduction :-** Renewable & Nonrenewable sources. Solar **Radiation :** Solar constant, basic earth-sun angles. Spectral distribution of extra terrestrial radiations & its variation. Solar time, Direction of beam radiation, computation of radiation on inclined surfaces. **(7 Hrs)**

**UNIT II: Radiation Transmission through covers:-** Reflection and absorption of radiation, optical properties of cover systems transmittance effects of surface layers on transmittance, transmittance absorptance product. Solar Energy collections:- Heat transfer for solar energy utilization, flat plate collectors such as liquid & air collector. Introduction to various systems of concentrating collectors. **(7 Hrs)**

**UNIT III:** Solar energy Utilization:- Application of solar energy in heating, cooling, pumping, power production, distillation, drying, solar cookers, solar pond, solar furnace. Solar Energy Storage :- Methods of storage such as sensible, latent heat & thermo-chemical storage, selection of method of storage, properties of storage materials and different arrangements of storages. (No analytical treatment) **(7 Hrs)**

**Section - B**

**UNIT IV: Energy from Ocean:-** Tidal Power:- types of tidal plants such as single and two basin plants, power developed & operation of tidal power plant. Ocean thermal energy conversion system. Ocean temp. profile, OTE power plant development, controlled flash evaporation, indirect vapour cycle. Wind Power:- Wind speed data, power in the wind, wind power development, types of wind mills, application for pumping and power generation. (No numerical) **(7 Hrs)**

**UNIT V: Biomass Energy Resources:** Mechanism of green plant photosynthesis. efficiency of conversion, solar energy plantation, biogas – Types of biogas plants, factors affecting production rates. Pyrolysis, Gasifiess : Types & classification. Straight vegetable oils as a liquid fuels and their properties. Introduction to bio-diesel as a diesel engine fuel. **(7 Hrs)**



**UNIT VI:** Direct Energy Conversion:- Photo voltaic cells : Principle, concept of energy conversion, conversion efficiency, power output and performance, storage. Fuel Cells: Principles types of fuel cells, conversion efficiency. Geothermal Energy Resources, power generation methods like vapour dominated, water dominated, flash steam, binary fluid and total flow concept of power generation. (7 Hrs)

**Books Recommended:**

**Text Books:-**

1. Solar Energy; S.P. Sukhatme; TMH
2. Non-Conventional Energy Sources; G.D. Rai; Khanna Publications

**Reference Books:-**

1. Treatise on Solar Energy; H.P. Garg; John Wiley & Sons.
2. Renewable Energy Conversion, Transmission and Storage; Bent Sorensen; Elsevier Publication
3. Renewable Energy; Godfrey Boyle; Oxford University Press, Mumbai
4. Renewable Energy Sources and Emerging Technology; D.P. Kothari, K.C. Singal, Rakesh Ranjan; PHI

**6FEME05 FREE ELECTIVE-II  
(3) ENERGY MANAGEMENT**

**Section-A**

**UNIT-I:** Introduction to energy, Sources of energy, Forms of energy, Energy reserves, renewable energy sources, Units of energy. Energy consumption and GDP. Need and importance of energy conservation and management (7 Hrs)

**UNIT-II:** Energy audit concepts, Mass and Energy balances, Energy Auditing-methodology, analysis and reporting, Evaluation of energy conserving opportunities, Economic analysis and life cycle costing. (7 Hrs)

**UNIT-III:** Energy conservation in steam generation and supply system. Boiler performance, Boiler efficiency (direct and indirect method), excess air, flue-gas monitoring. (7 Hrs)

**Section - B**

**UNIT-IV:** Energy conservation Energy conservation in compressed air systems, refrigeration and air-conditioning systems and water systems. Elementary coverage of energy conservation in pumps and fans. Opportunities in Process Industries for Energy conservation. (7 Hrs)

**UNIT-V:** Electrical energy conservation in building lighting, heating, ventilating and air conditioning, Energy efficient motor, power factor improvement in power systems. (9Hrs)

**UNIT-VI:** Energy environment interaction, Environmental issues, Global warning, Carbon dioxide emissions, Depletion of ozone layer, Government's regulations, Energy economy interaction. (7 Hrs)

**Books Recommended**

**Text Books:**

1. P.H. Henderson; India – The Energy Sector; Oxford University Press.
2. D. A. Ray; Industrial Energy Conservation; Pergamon Press.

**Reference Books:**

1. W.S. Turner; Energy Management Handbook (Wiley)..
2. Rajan; Optimizing Energy Efficiency in the Industry, Tata McGraw Hill Publishers.
3. C.L Capehart; Guide to Energy Management, Fairmont Press.

**6ME06 COMMUNICATION SKILLS**

**Unit I :** Comprehension over an unseen passage.  
Comprehension - A - word study :- Synonym, antonym, meanings, matching words, adjectives, adverbs, prefix and suffix, correct forms of commonly misspelled words, understanding of the given passage, reading  
Comprehension - B - Structure study :- Simple and compound sentences, types of conjunctions, singular and plural, tenses and their effect on verb forms. Use of - not only - but also, if clause, since, may, can, could, would, too etc.  
Active and passive forms, negative and interrogative, punctuation and capitalization. Summary, Precise & abstract writing. (10 Hours)

**Unit II:** Theoretical background - importance of communication, its process, model of communication its components & barriers. Verbal communication, its significance, types of written communication, organization of a text (Titles, summaries, headings, sequencing, signaling, cueing etc.), Important text factors (length of paragraph, sentences, words, clarification and text difficulty). Evaluation of written communication for its effectivity and subject content.  
Non-verbal communication, types of graphics and pictorial devices. (10 Hours)

**Unit III:** Specific formats for written communication like – business correspondence, formal reports, technical proposals, research papers and articles, advertising and graphics. Format for day-to-day written communication like writing applications, Resume, notices, minutes, quotations, orders, enquiries etc. Claim letter.

Oral communications - Important objectives of interpersonal skills, soft skills(listening, speaking strategy), (verbal and non-verbal), face to face communications, group discussion and personal interviews.

Methodology of conduction of meetings, seminars, symposia, conference and workshop.

**(10 Hours)**

#### **BOOKS RECOMMENDED :**

- 1) Krishna Mohan, Meera Banerjee : Developing Communication Skills, MacMillan India Limited.
- 2) M.A. Rizvi: Effective Technical communication, Tata McGraw Hill.
- 3) Urmila Rai & S.M.Rai : Communication Skills ,Himalaya Publisher House.
- 4) Chrissie Wright (Editor) : Handbook of Practical Communication Skills, Jaico Publishing House.
- 5) Dr. Nageshwar Rao & Dr. Rajendra P. Das : Communication skills, Himalaya Publisher House.

#### **5IT08 Communication Skills Lab:**

##### **Lab based on syllabus of 5IT08.**

**Objective:** On completion of this laboratory the candidate should be able to demonstrate adequate skills in oral and written communication for technical English language actively participate in group discussions and interviews and exhibit the evidence of vocabulary building. Candidates should be assessed through continuous monitoring and evaluation. The sample list of experiments is given below. This list can be used as guideline for problem statements but the scope of the laboratory should not be limited to the same. Aim of the list is to inform about minimum expected outcomes.

1. Assignments and tests for vocabulary building
2. Technical report writing
3. Group discussions
4. Interview techniques
5. Projects and tasks such as class news letter
6. Writing daily diaries and letters
7. Interactive language laboratory experiments.

**TEXT BOOK:** Norman Lewis: Word Power Made Easy

#### **5IT09 Computer Lab- III (VC++) :**

This laboratory shall be based on MFC using VC++. Minimum eight programs based on the following:

- i) MFC application creation
- ii) Using dialog boxes
- iii) Windows common controls
- iv) Document / View architecture
- v) Printing with MFC

**Reference :**J. Prosise: Programming Windows with MFC (Microsoft Press).

#### **6ME07 FLUID POWER –II-LAB.**

##### **Practical Term Work :**

At least seven exercises based on the following.

- 1) Trial/study of Pelton turbine.
- 2) Trial/study of Francis turbine.
- 3) Trial/study of Kaplan Turbine.
- 4) Trial/study of centrifugal pump.
- 5) Trial/study of reciprocating pump.
- 6) Trial/study of Axial flow pump.
- 7) Study of multistage pump.
- 8) Trial/study of Hydraulic Ram.
- 9) Study of Hydrostatic components systems.
- 10) Study of Hydrostatic systems.
- 11) Study of Hydrokinetic systems.
- 12) Study of Cavitation phenomena.
- 13) Study of governing of Impulse Turbines.
- 14) Study of governing of reaction turbines.
- 15) Study of Special pumps (Air lift pump/jet pump)
- 16) Formulation of problem concerning the fluid flow in the vessel with any commercial code available like CFX, FLUENT, PHOENIX.  
Practical examination shall consist of oral/and or experimentation based on above term work.

#### **6ME08 COMPUTER SOFTWARE APPLICATIONS –II –LAB.**

##### **Practicals:**

1. At least four practical's using SQL for mechanical applications.
2. Demonstration of simulation packages Practical examination shall consist of oral based on above term work and syllabus.

#### **6ME09 THEORY OF MACHINES –II-LAB.**

##### **Practicals:-**

At least eight practical from the following list

- 1) Determination of inertia of simple pendulum.
- 2) Determination of inertia of compound pendulum.
- 3) Determination of inertia of irregular bodies.
- 4) Experiment on state balancing of rotating masses.
- 5) Experiment on dynamic balancing of rotating masses.
- 6) Determination of gyroscopic couple.
- 7) Experiment on whirling speed of shaft.
- 8) Determining the interrtia force of connecting rod by
- 9) Dynamic force analysis of four bar mechanism
- 10) Experiment on free and damped vibration of systems with one degree of freedom.
- 11) Experiment on forced damped vibration of systems with one degree of freedom.

**SYLLABUS PRESCRIBED FOR BACHELOR OF ENGINEERING  
ELECTRICAL ENGINEERING (ELECTRONICS & POWER) /  
ELECTRICAL AND ELECTRONICS ENGINEERING/  
ELECTRICAL ENGINEERING (ELECTRICAL & POWER)/  
ELECTRICAL ENGINEERING  
SEMESTER PATTERN  
FIFTH & SIXTH SEMESTER  
SEMESTER : FIFTH**

**5EX01 CONTROL SYSTEMS**

**SECTION-A**

**Unit I : Introduction to automatic control :** open loop and closed loop system, servo-mechanisms, mathematical modeling of physical systems, transfer functions, block diagrams and signal flow graphs. Effect of feed back on sensitivity to parameter variation and reduction of the noise.

**Unit II : Control System Components :** Electrical / Electro-mechanical components such as A.C./D.C. servomotors, stepper motors, synchors, potentiometers, tachogenerators, their functional analysis and operating characteristics and their application. Pneumatic controls devices.

**Unit III: Time response analysis :** time response of first and second order systems to standard inputs. Time response specifications, types of system, error analysis, error coefficients, steady state errors, dynamic error series.  
Approximate methods for higher order system, proportional, derivative and integral control.

**SECTION-B**

**Unit IV: Stability :** stability of control systems, characteristics equation, impulse response, Routh-Hurwitz stability criterion, relative stability.  
Root Locus : construction of root locus, determination of roots from root locus conditions on variable parameter for stability, effect of addition of poles and zeros.

**Unit V : Frequency response methods :** frequency response of linear system, specification, Logarithmic frequency response (Bode) plots from transfer function for various systems. Polar plots for various systems. Estimation of approximate transfer function from the frequency response., Stability analysis from Bode plots. Nyquist criterion, Nyquist plots and stability analysis

**Unit VI :** State, state space and state variables; SISO/MIMO linear systems state variable models - differential equations, Transfer Functions, Block Diagrams and State Diagrams (Signal Flow Graphs); Transfer functions decomposition - Phase variable forms, Canonical forms and Jordan canonical form; Transfer function - state model; Transfer matrix; State equations solution - State transition matrix (STM); STM Computation – Laplace transformation, Canonical transformation and Cayley Hamilton theorem; Time response – SISO Systems. Concept - controllability and observability, Kalman & Gilbert test

**TEXT BOOKS :**

1. Control Engineering, D.Ganesh Rao, k.Chennavenkatesh, 2010
2. Modern Control System, Richard Dorf, Robert Bishop, 11<sup>th</sup> edition 2008
3. Nagrath I.J., Gopal M. : Control System Engineering, Wiley Eastern.'
4. Ogata K. : Modern Control Systems, Prentice Hall of India.
5. Control System Engineering, R Anandanatarajan, P Ramesh Babu, SCITECH Publications, Chennai, 2<sup>nd</sup> edition, 2010

**PRACTICALS :** Minimum 10 No. of experiments are to be performed, based on above syllabus.

**5 EX02 DIGITAL ELECTRONICS**

**Unit-I :** Definitions for Digital Signals, Digital Waveforms, Digital Logic, Moving and Storing Digital information, Digital Operations, The Basic Gates—NOT, OR, AND, Universal Logic Gates—NOR, NAND AND-OR-Invert GATES, Positive and Negative Logic.

**Unit-II: Combinational Logic circuits:** Boolean Laws And Theorems, Sum-of-products Method, Truth Table to Karnaugh Map, Pairs, Quads, and Octets, Karnaugh Simplifications Don't-care Conditions, Product-of-sums Method, Product-of-sums Simplification, Simplification by Quine-McClusky Method, Hazards and Hazard Covers.

**Unit-III: Data-processing circuits:** Multiplexers, Demultiplexers, 1-of-16 Decoder, BCD-to-decimal Decoders Seven-segment Decoders, Encoders, Exclusive-or GATES, Parity Generators and Checkers, Magnitude comparator, Read-only Memory.

**Unit-IV: Number systems and codes:** Binary Number System, Binary to decimal Conversion, Decimal-to-binary Conversion, Octal Numbers, Hexadecimal Numbers, The ASCII Code, The Excess-

3 Code, The Gray Code. Unsigned Binary Numbers, Sign-magnitude Numbers, 2'S Complement Representation.

**Unit-V: Arithmetic circuits:** Binary Addition, Binary Subtraction, 2'S Complement Arithmetic, Arithmetic Building Blocks, The Adder-subtractor, Fast Adder, Arithmetic Logic Unit, Binary Multiplication & Division.

**Unit-VI: Clocks and Timers:** Clock Waveforms, TTL Clock, Schmitt Trigger. Flip-Flops: RS Flip-flops, Gated Flip-flops, Edge-triggered RS Flip-flops, Edge-triggered *D* Flip-flops, Edge-triggered *JK* Flip-flops, Flip-flop Timing, *JK* Master-slave Flip-flops, Analysis of Sequential Circuits.

**Text-Book :**

Donald P Leach, Albert Paul Malvino, Goutam Saha, "Digital Principles & Applications" (6/e) (McGraw-Hill).

**Reference books:**

1. Mano M. & Kime "Logic & Computer Design Fundamentals" (2/e) (Pearson Education).
2. Taub & Schilling "Digital Integrated Electronics" (TMH).
3. Jain R.P. "Modern Digital Electronics" (TMH).
4. Mano M. & Kime "Logic & Computer Design Fundamentals" (2/e) (Pearson Education).
5. M.Morris Mano "Digital Design" (2/e) (PHI).

**5EP03/ 5EX03/ 5EL03 / 5EE03 ELECTRICAL MACHINES - II**

**SECTION-A**

**Unit I :** Fundamentals of AC rotating machines. AC windings- integral slot, fractional slot and fractional pitch windings- distribution factor, pitch factor and winding factor-harmonic mmf of distributed windings, EMF equation.

**Unit II :Synchronous Generators :** constructional details, armature reaction-circuit models and phasor diagram of salient and non salient pole machines - determinations of parameters of the circuit models - methods of determining regulations and efficiency, transient and subtransient reactances.

**Unit III :** **A) Synchronous Motors :** principle of operation - torque equation - circle diagrams- V-curves - hunting and damping starting applications.

**B) Methods of synchronization** - synchronous machine on infinite busbars - parallel operation of generators. Introduction to conducting and reporting the test on synchronous machine as per IS.

**SECTION-B**

**Unit IV :** Three phase induction motor : rotating magnetic fields, principles of operation-constructional details - circuit models and phasor diagram, performance equations direct and indirect testing-circle diagram.

**Unit V :** Methods of starting and speed control of 3 phase IM-double cage motor-methods of braking-single phasing, cogging and crawling, scharge motor.

**Unit VI:A) Single phase IM :** different types - starting methods - characteristics and applications.

B) AC commutator machines-series motors - characteristics and applications.

C) Small machines-principle of operation, construction characteristics and applications of Printed Circuit Motor (PCM), Syn, ind motor, reluctance motor and hysteresis. Introduction to conducting and reporting the test on single phase induction motor as per IS.

**TEXT BOOKS :**

1. Theory of AC Machines : A.S.Langsdorf (McGraw Hill)
2. Performance and Design of AC Commutator Motors - Openshov - Taylor (McGraw Hill)
3. Performance and Design of Alternating Current Machines : M.C.Say,
4. Electrical Machines - Nagrath, Kothari. (Tata McGraw Hill)
5. Latest Indian Standard guide for testing synchronous machine and single phase induction motor.

**PRACTICALS :** At least Ten experiments based on the above syllabus.

**5EP04/5EL04/ 5EE04 SIGNALS AND SYSTEMS**

**SECTION -A**

**Unit I : Introduction to Signals and Systems:** •Signals and Systems, Classification of Signals Classification of Systems, Systems Modeling Some Ideal Signals, Energy and Power Signals Frequency Response, Discrimination of Continuous-Time Signals Topological Models, Analysis of Continuous-Time Systems Time Domain and Frequency Domain, Properties of Elementary Signals Linear Convolution Integral, Response of Continuous-Time Systems.

**Unit II : Fourier series and Its Properties** Fourier Transform Properties of Fourier Transform, Tables of Fourier Transform Pairs Fourier Transform of Periodic Signals, Ideal Low-Pass Filter

Frequency-Domain Analysis of Systems Fourier analysis of Sampled Signals

**Unit III : Analysis of LTI Discrete-Time Systems:** Time Domain and Frequency Domain, Properties of Discrete-Time Sequences Linear Convolution, Discrete-Time System Response

### SECTION - B

**Unit IV : Sampling:** Representation of a continuous–Time Signal by its Samples; The Sampling Theorem; Reconstruction of Signals from its Samples using Interpolation; Effect of Under Sampling (Frequency Domain Aliasing); Discrete Time processing of Continuous–Time Signals

**Unit V : The Z Transform:** The Z Transform; The Region of Convergence for the Z- Transform; Geometric Evaluation of the Fourier Transform from the Pole-Zero Plot; Properties of Z-Transform; Analysis and Characterization of Discrete-Time LTI Systems using Z-Transform; System Transfer Function; Block Diagram Representation; The Unilateral Z-Transform; Solution of Difference Equation using the Unilateral Z-Transform.

**Unit VI : Discrete Fourier Transform and Fast Fourier Transform** Representation of Discrete-Time aperiodic signals and the Discrete-Time Fourier Transform; Fourier Transform for Periodic Signals; Properties of the Discrete-Time Fourier Transform; Discrete-Time LTI Systems and Discrete-Time Fourier Transform. Fast Fourier Transform (FFT)

#### Books Recommended:

- 1) PRINCIPLES OF LINEAR SYSTEMS AND SIGNALS, 2E(international version) – Lathi B. P. Oxford University Press
- 2) Signals & Syatems, Smarajit Ghosh, PEARSON education, 2006
- 3) Signals & Syatems,D Ganesh rao, satish Tunga, PEARSON education 2010
- 4) PRINCIPLES OF SIGNAL PROCESSING & LINEAR SYSTEMS (international version) Lathi B P . Oxford University Press
- 5) Signals And Systems , S.Haykin, 2nd Edition, John Wiley And Sons 1999
- 6) Analog And Digital Signal Processing , Ambardar A, 2/3; Thomson Learning-2005
- 7) Signals and systems, Oppenheim and Schafer Prentice Hall India Of India 2nd Edition 1997

### 5 EX04 ELECTRICAL POWER - I SECTION-A

**Unit I: Transmission line parameters :** calculation of resistance, inductance and capacitance of single phase and three phase transmission lines, skin effect and proximity effect, transposition,

G.M.D. & G.M.R. methods, double circuit lines, bundled conductors, effect of earth on inductance and capacitance, interference with communication lines. (10)

**Unit II :Electrical characteristics of transmission line :** V-I characteristics of short, medium and long lines, A, B, C, D constants, nominal TI and equivalent T representations, Ferranti effect, corona phenomenon, effect of corona and power loss due to corona.

Representation of power systems : per unit system and one-line reactance diagrams. (10)

**Unit III : Voltage control and power factor improvement :** receiving and sending end power circle diagrams, methods of voltage control and power factor improvement, use of static VAR generators and synchronous phase modifiers, analytical and graphical methods, automatic voltage control. (10)

### SECTION-B

**Unit IV : Load flow studies :** load flow problem, classification of buses, network modeling, Y-bus and Z-bus matrices, load flow equation, Gs and NR methods, comparison of methods used. (10)

**Unit V :Mechanical design :** materials used, types of insulators, comparison of pin type and suspension type insulators, voltage distribution and string efficiency, methods of increasing string efficiency, grading rings and arcing horns. Introduction to insulator testing, line supports for LV, HV and EHV, Sag calculation, stringing charts.

**Unit VI : Underground cables :** material used for conductor & insulation : different types of cables and their manufacture, parameters of underground cable, grading of cable losses, break down and rating, testing of cables.

#### Text Books :-

1. Power System Engineering by D.P. Kothari, I.J. Nagrath TMH 2<sup>nd</sup> edition, 9<sup>th</sup> reprint 2010.
2. Power System Analysis, N.V.Ramana, Pearson education, 2010
3. Power System Analysis, Arthur R. Bergen, Vijay Vittal,2<sup>nd</sup> Edition, 2009, PEARSON Education
4. I. J. Nagrath & D. P. Kothari – “Modern Power System Analysis”, Tata- Mc-Graw Hill Publishing Company, New Delhi.
5. Power System Analysis by Hadi Saadat TMH, 1<sup>st</sup> edition 2011.
6. Electrical Power System, by Syed A. Nasar TMH, Revised 1<sup>st</sup> Edition 2011

**Reference Books :-**

1. S. Rao – “EHV A.C. and HVDC Transmission Engineering and Practice”, Khanna Publishers, New Delhi.
2. Narain G. Hingorani and Lazlo Gyugyi – “Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems.
3. Yong Hua Song and Allan T. Johns - “Flexible AC transmission Systems (FACTS), T and D reference book” Westing house.

**FREE ELECTIVE - I****5FEEP05/ 5 FEEX05/ 5FEEL05 / 5FEEE05****(1) ENERGY AUDIT & MANAGEMENT****SECTION - A****Unit -I :Energy Scenario & Management:**

Indian energy scenario, Energy needs of growing economy, Energy pricing in India Energy sector reforms, various forms of energy, Primary and secondary energy, commercial and non commercial energy, Global primary energy reserves, Energy and environment, Necessity of conserving energy, Energy strategy for the future, Electrical energy management, Concept of supply side management and demand side management, Methods of implementing Demand side management and advantages to consumer, utility and society.

**Unit-II: Energy Audit:** Definition, Need of energy audit, Preliminary and detailed energy audit. Procedure for carrying out energy audit, Instruments used for energy audit, Data Analysis-Energy–production relationship, specific energy consumption, Sankey diagram, CUSUM Technique, Bench marking energy performance, Recommendations for energy conservation, Action plan, Executive Summary.

**UnitIII: Economics of energy conservation:** Cost factors, Budgeting, Standard costing and Sources of capital, Cash flow diagram and activity chart, Simple Pay back period analysis, Time value of money, Net present value method, internal rate of return method, Profitability index for benefit cost ratio.

**SECTION - B**

**Unit IV: Energy Conservation:** Energy conservation in motive power, Illumination, Heating & cooling systems, Pumping systems ,Thermal power stations and Transmission & Distribution Sector. Cogeneration &Waste heat recovery systems.

**Unit-V: Energy Audit Case Studies:** Energy Intensive Industries, Commercial ,Industrial, Municipal and Agriculture Sector, IT industries, Hospitals.

**UnitVI: Fundamentals of Harmonics:** Harmonic distortion, voltage versus current distortion, Power systems quantities under non sinusoidal conditions- active reactive and apparent power, displacement and true power factor, harmonic phase sequences, triplen harmonics, harmonic indices- Total harmonic distortion(THD), Total demand distortion(TDD) , Harmonic sources from commercial and industrial load, Locating harmonic sources, Power quality monitoring.

**Reference Books:**

1. Electrical Energy Utilization & Conservation Dr. S.C. Tripathi, TMC
2. Energy Coservation and Audit Thumman
3. Energy Audit and Conservation TERI
4. Guide book for national certification examination for Bureau of Energy Efficiency energy managers and energy auditors.
5. Electrical power system quality systems Surya Santoso/ H. W. Beaty, TMH Publication.

**FREE ELECTIVE - I****5FEEP05/ 5 FEEX05 / 5FEEL05 / 5FEEE05****(2) ELECTRICAL DRIVES****SECTION - A****Unit-I : Concept of Electrical Drives:**

Electric Drives: Definition, Advantages, components, Selection. Latest trends in DC & AC Drives, Dynamics. Equivalent values of drive parameters. Load Torque: Components, Natures and classification. Steady state stability: Speed torque characteristics, criteria. Load equalization.

**Unit-II: Electrical Braking:**

Electrical braking methods, characteristics of DC Motors: Rheostatic, Plugging, and Regenerative. Electrical braking method of three phase induction motor: DC Dynamic Braking, Plugging, Regenerative Braking, AC Rheostatic braking.

**Unit-III: Solid State Controlled D.C. Motors:**

Fully controlled converter: Single phase, three phase and effect on performance of separately excited DC Motor. Chopper control converter: Close loop control of DC series motor in a drive.

**SECTION B****Unit-IV: Solid State Controlled Induction Motors:**

Steady State Analysis, Thyristorised stator voltage control, Transistorised stator frequency control: V/f control, voltage source inverter (VSI) control, current source inverter (CSI) control, Steady State Analysis, Relative merits and demerits of VSI and CSI for induction motor drive.

**Unit-V:** Energy Saving in starting of Induction Motor Drive: Types, rotor resistance, reduced voltage, use of magnetic amplifier. Energy Saving in running of induction motor driving pump and blower: Consideration of load torque characteristics and energy saving calculations. Power Rating: Load diagram, Heating and cooling, Thermal Resistance, Selection of motor power capacity, Derating of motor, effect of harmonic current, short time rating.

**Unit-VI: Industrial Applications and Latest trends in Drives:**

Industrial Applications: Drives for Rolling mills (Four Quadrant Operation), Machine tools (Constant Torque Application), Textile mills (Synchronized operation of Drive in Tandem), Sugar Mills: Centrifuged Drive. Latest trends in Drives: Commutatorless DC Motor, Servo Drives, Stepper motors.  
**Energy Saving Techniques and Power Rating of Drive Motor:**

**Reference Books :-**

1. G. K. Dubey, "Fundamentals of Electric Drives", 2nd Edition, Narosa Publishing House
2. N. K. De, P. K. Sen, "Electric Drives", Prentice Hall of India Eastern Economy Edition
3. S. K. Pillai, "Analysis of Thyristor Power Conditioned Motors", University Press
4. V. Subrahmanyam, "Electric Drives: Concepts & Application", Tata Mc-Graw Hill
5. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education
6. R. Krishanan, "Electric Motor Drives – Modeling Analysis and Control", PHI India

**5EP06 /5 EX 06/5EL06/5EE06 COMMUNICATION SKILLS**

**Unit I :** Comprehension over an unseen passage. Comprehension – A - word study :- Synonym, antonym, meanings, matching words, adjectives, adverbs, prefix and suffix, correct forms of commonly misspelled words, understanding of the given passage. Comprehension - B - Structure study :-Simple and compound sentences, types of conjunctions, singular and plural, tenses and their effect on verb forms. Use of - not only - but also, if clause, since, may, can, could,would, too etc. Active and passive forms, negative and interrogative, punctuation and capitalization.

**Unit II :** Theoretical background - importance of communication, its process, model of communication its components & barriers. Verbal communication, its significance, types of written communication, organization of a text (Titles, summaries, headings,

sequencing, signaling, cueing etc.), Important text factors (length of paragraph, sentences, words, clarification and text difficulty). Evaluation of written communication for its effectivity and subject content. Non-verbal communication, types of graphics and pictorial devices.

**Unit III:**Specific formats for written communication like – business correspondence, formal reports, technical proposals, research papers and articles, advertising and graphics. Format for day-to-day written communication like applications, notices, minutes, quotations, orders, enquiries etc. Oral communications - Important objectives of interpersonal skills, (verbal and non-verbal), face to face communications, group discussion and personal interviews. Methodology of conduction of meetings, seminars, symposia, conference and workshop.

**BOOKS RECOMMENDED:**

- 1) Krishna Mohan, Meera Banerjee : Developing Communication Skills, MacMillan India Limited.
- 2) Chrissie Wright (Editor) : Handbook of Practical Communication Skills, Jaico Publishing House.
- 3) Raman Sharma "Technical Communication", Oxford University Press..
- 4) F.Frank Candlin : General English for Technical Students, University of London Press Ltd.

**5EX 07 CONTROL SYSTEM LAB.**

Any TEN experiments based on contents of  
5EX01 CONTROL SYSTEM - I

**5EX08 DIGITALELETRONICSLAB**

Any TEN experiments based on contents of  
5EX02DIGITALELECTRONICS

**5EP09/5EX09/5EL09/5EE09 ELECTRICAL MACHINES - II - LAB**

Any TEN experiments based on contents of  
5EP03 /5EX03/5EL03/5EE02 ELECTRICAL MACHINES - II

**5EP10/5EX10 /5EL10 /5EE10  
COMMUNICATIONSKILLSLABORATORY**

**Objective :** On completion of this laboratory the candidate should be able to demonstrate adequate skills in oral and written communication for technical English language, actively participate in group discussions and interviews and exhibit the evidence of vocabulary building. Candidates should be assessed through continuous monitoring and evaluation. The sample list of experiments is given below. This list can be used as guideline

for problem statements but the scope of the laboratory should not be limited to the same. Aim of the list is to inform about minimum expected outcomes.

1. Assignments and tests for vocabulary building
2. Technical report writing
3. Group discussions
4. Interview techniques
5. Projects and tasks such as class news letter
6. Writing daily diaries and letters
7. Interactive language laboratory experiments.

**Text Books :** i. Norman Lewis : Word Power Made Easy  
<http://www.teachingenglish.org.uk> ii. Ghosh: "Technical Communication", Oxford University Press.

### SEMESTER : SIXTH

#### 6 EX 01 DIGITAL SIGNAL PROCESSING

##### SECTION - A

**UNIT-I:** Introduction to DSP, Frequency domain description of signals & systems, Discrete time sequences systems, Linearity unit sample response, Convolution, Time invariant system, Stability criteria for discrete time systems, Solutions of linear difference equations.

**UNIT-II :** Introduction to Fourier transform of Discrete Time Signal and its properties, Inverse Fourier transform, DFT and its properties, Circular convolution, Linear convolution from DFT, FFT, decimation in time and frequency algorithm.

**UNIT-III:** Sampling of Bandpass signals-Representation of Bandpass signals, sampling of bandpass signals, discrete time processing of continuous time signal; Analog to digital conversion-sample and hold, quantization and coding, analysis of quantization errors, oversampling of A/D converter; Digital to Analog conversion-sample and hold, first order hold, linear interpolation with delay, oversampling of D/A converter

##### SECTION-B

**UNIT-IV:** Filter categories, Direct form I, Direct form II, Cascade and parallel structure for IIR and FIR Filter, Frequency sampling structures for F.I.R. filter, Steps in Filter Design, Design by Pole Zero Placements, FIR filter design by Windowing method, Rectangular, Triangular and Blackman window.

**UNIT-V:** Analog filter types, Butter worth, Elliptic filter, Specification and formulae to decide to filter order, Methods to convert

analog filter into IIR digital, Mapping of differential, Impulse invariant, Bilinear, Matched Z transformation.

**UNIT-VI:** DSP Processors and applications- DSP Microprocessors architectures, fixed point, floating point precision, algorithm design, mathematical, structure and numerical constraints, DSP programming, filtering, data conversion; Real time processing consideration including interrupts

##### TEXT BOOKS:

1. Proakis & Monolakis D.G, 'Digital Signal Processing', PHI Publication
2. Oppenham & Scheffer, 'Discrete Time Processing', John Wiley Publication
3. Digital Signal Processing, P Ramesh Babu, SCITECH Publications, Chennai, 4<sup>th</sup> edition, 2010
4. Mitra S.K, 'Digital Signal Processing', TMH Publication

### 6EP02/ 6 EX 02/ 6EL02/ 6EEO2

#### OPTIMISATION TECHNIQUES

##### SECTION-A

**Unit I :** Introduction, engineering applications of optimization, statement of an optimization problem, optimization techniques, classical optimization problem, optimization techniques. Classical optimization techniques - single and multi variable optimization with and without constraints.

**Unit II :** Linear programming I - standard form, definitions and theorems, graphical method, solution of system of linear simultaneous equations, simplex method, two phase simplex method, revised simplex method.

**Unit III:** Linear programming II - duality, theorems on duality, dual simplex method, decomposition principle, sensitivity analysis, balanced and unbalanced transportation problems.

##### SECTION-B

**Unit IV:** Non linear programming - unimodal function, unrestricted search, Fibonacci search method and Golden section method, unconstrained optimization, direct search methods - pattern search methods, simplex method, descent method - steepest descent method, conjugate gradient and variable metric method.

**Unit V :** CPM and PERT introduction - Network representation of project, critical path, optimum scheduling by CPM, crashing of project.

**Unit VI:** Dynamic programming : multistage decision processes, principle of optimality, sub optimization, calculus and tabular method of solution, conversion of final value problem into initial value



problem, solution of linear programming. Continuous dynamic programming.

#### BOOKS :

- 1) S.S.Rao : Optimization - Theory & Application, Wiley Eastern Ltd.
- 2) L.S.Srinath : PERT and CPM Principles & Application, Affiliated East West Pvt. Ltd., New Delhi.
- 3) Operation research by Richard Bronson,

#### REFERENCE BOOKS :

- 1) Fredrick S.Hiller Gerald J.L. Lieberman : Introduction Operations Research, Tata McGraw Hill Pub. Co., New Delhi.
- 2) H.A.Taha : Operations Research, PHI, New Delhi.
- 3) P.K.Gupta & D.S.Hira : Operations Research, S.Chand & Co. Ltd, New Delhi.
- 4) J.C.Pant : Introduction to Optimization, Jain Brothers, New Delhi.

### 6EX03 ELECTRICAL POWER - II

#### SECTION - A

**Unit I:** **Symmetrical components** Definition and choice, Alpha operator, transformation matrices, sequence components, power invariance, line and phase sequence quantities relations, three phase delta/star transformer bank- sequence voltages and currents relationship; power system elements – sequence impedance and sequence networks ; Various three phase transformer connections – zero sequence rules; Unbalanced load system – application.

#### Unit II : Symmetrical Fault Analysis

Transmission line transients, three phase symmetrical short circuit at alternator terminals, Power system fault calculations, short circuit MVA, Current limiting reactors, ring system and tie bar system, Circuit breaker rating calculation.

#### Unit III : Unsymmetrical Fault Analysis

L-G, L-L-G and L-L faults at unloaded generator terminals, Equivalent sequence network diagram, Fault impedance, Unsymmetrical faults through impedance, Power system faults-loaded and unloaded conditions.

#### SECTION-B

#### Unit IV :Over voltages

Causes – internal and external; Voltage surge, Basic insulation level, Protection – earthing screen, overhead ground wire, lightning arresters.

**Unit V:** HVDC Transmission Basic principle, Transmission equipments, Comparison with AC links, Inverters – reactive power requirement; Converters, DC links, Circuit breaking, ground return, Economic distance, modern developments.

### Unit VI :Flexible AC Transmission Systems (FACTS)

FACTS concept, Elements, Controllers, Comparison with Conventional AC Transmission system.

#### Text Books :-

1. Power System Engineering by D.P. Kothari, I.J. Nagrath TMH 2<sup>nd</sup> edition, 9<sup>th</sup> reprint 2010
2. Power System Analysis, N.V.Ramana, PEARSON education, 2010
3. Power System Analysis, Arthur R. Bergen, Vijay Vittal, 2<sup>nd</sup> Edition, 2009, PEARSON Education
4. I. J. Nagrath & D. P. Kothari – “Modern Power System Analysis”, Tata- Mc-Graw Hill Publishing Company, New Delhi.
5. Power System Analysis by Hadi Saadat TMH, 1<sup>st</sup> reprint 2004
6. Electrical Power System, by Syed A. Nasar TMH, Revised 1<sup>st</sup> edition 2011.

#### Reference Books :-

1. S. Rao – “EHV A.C. and HVDC Transmission Engineering and Practice”, Khanna Publishers, New Delhi.
2. Narain G. Hingorani and Lazlo Gyugyi – “Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems.
3. Yong Hua Song and Allan T. Johns - “Flexible AC transmission Systems (FACTS), T and D reference book” Westing house.

**Practicals :** Minimum eight experiments based on above syllabus, preferably with uniform distribution.

### 6EX04 MICROPROCESSORS & MICROCONTROLLERS

#### SECTION-A

**Unit I :** 8085 : architecture, register structure, addressing modes, instruction set of 8085, timing diagrams.

**Unit II :** Assembly Language Programming of 8085, counters and time delays, stack and subroutines, Memory mapped I/O and I/O mapped I/O, address decoding techniques. Interrupt system of 8085 (software and hardware interrupts). Data transfer schemes, serial data transfer through SOD and SID line.

**Unit III :** Interfacing devices (I) : internal architecture and programming of PPI (8255), PIC (8259), USART (8251).

#### SECTION-B

**Unit IV : Interfacing devices (II) :** architecture and programming of programmable interval timer (8253), floppy disc controller (8272), programmable CRT controller (8275), DMA controller (8237). Introduction to architecture 8086.

**Unit V: Microprocessors applications :** hardware & software developments : signal conditioning & data acquisition system components. Measurement of pulse width using parallel port, SID lines, interrupts and timer and counter. Magnitude measurement techniques : rectification, sampling etc. Measurement of fundamental quantities (voltage, current, frequency, speed) and derived quantities (resistance, inductance, capacitance, phase angle, power factor).

**Unit VI: Introduction to microcontroller:** 8051 architecture , 8051 Internal resources, pin diagram, I/O pins, ports and their internal logic circuits, counters, serial ports, interrupt structure, SFRs and their addressing, watch-dog timer, internal code memory, data memory, stack pointer, flags, bit addressable memory, comparative study 8051 families by different manufacturers, study of instruction set of 8051.

#### TEXT BOOKS :

- 1) Microprocessor Architecture, Programming, and Applications with the 8085 , Romesh Gaonkar PHI Publication -2006
- 2) Introduction to Microprocessor L.Gibson, Prentice-Hall 2003
- 3) The 8051 Microcontroller Scott MacKenzie Prentice-Hall, Inc -2006

#### REFERENCE BOOKS :

1. An Introduction to Microcomputers Volume 1 Basic Concepts, Adam Osborne Osborne-McGraw Hill, Berkely California, 1980
2. The 8051 Family of Microcontrollers Richard Barnett Prentice-Hall, Inc -2005
3. <http://www.nptel.iitm.ac.in/>
4. [www.ocw.mit.edu](http://www.ocw.mit.edu)

**PRACTICALS:** Uniformly distributed Minimum 10 practicals based on above syllabus.

#### FREE ELECTIVE - II

6FEEP05/ 6FEEX 05/ 6FEEL05/ 6FEEO5

(i) ELECTRICAL ESTIMATING & COSTING

#### SECTION - A

**Unit I: Drawing and IE rules :** Classification of Electrical Installation, General requirement of Electrical Installation. Reading and Interpretation of Electrical Engineering Drawings. Various diagrams, plans and layout, Important definitions related to Installation, IE rules related to Electrical Installation & Testing.  
**Service Connection :** Concept of service connection. Types of service connection & their features. Methods of Installation of service connection. Estimates of under ground & overhead service connections.

**Unit II: Residential Building Electrification :** General rules guidelines for wiring of Residential Installation and positioning of equipments. Principles of circuit design in lighting and power circuits. Procedures for designing the circuits and deciding the number of circuits.

Method of drawing single line diagram. Selection of type of wiring and rating of wires & cables. Load calculations and selection of size of conductor. Selection of rating of main switch, distributions board, protective switchgear ELCB and MCB and wiring accessories. Earthing of Residential Installation. Sequence to be followed for preparing Estimate Preparation of detailed estimates and costing of Residential Installation.

**Unit III: Electrification of commercial Installation :** Concept of commercial Installation. Differentiate between electrification of Residential and commercial Installation. Fundamental considerations for planning of an electrical Installation system for commercial building. Design considerations of electrical Installation system for commercial building. Load calculations & selection of size of service connection and nature of supply. Deciding the size of cables, busbar and busbar chambers. Mounting arrangements and positioning of switchboards, distribution boards main switch etc. Earthing of the electrical Installation Selection of type wire, wiring system & layout. Sequence to be followed to prepare estimate. Preparation of detailed estimate and costing of commercial Installation.

#### SECTION - B

**Unit IV: Electrification of factory unit Installation :** Concept of Industrial load. Concept of Motor wiring circuit and single line diagram. Important guidelines about power wiring and Motor wiring. Design consideration of Electrical Installation in small Industry/ Factory/ workshop. Motor current calculations. Selection and rating of wire, cable size & conduct. Deciding fuse rating, starter, distribution boards main switch etc. Deciding the cable route, determination of length of wire, cable, conduit, earth wire, and earthing. Sequence to be followed to prepare estimate. Preparations of detailed estimate and costing of small factory unit/ workshop.

**Unit V: Design & estimate for feeders & distributors :-** Different schemes for feeders & distributors, Design of feeders & distributors, Estimates for different feeders & distributors, Distribution transformer, Deciding Size & location, Estimate for outdoor & indoor type distribution substation.

**Testing of Installation:** Testing of wiring Installation for verification of current; earthing, insulation resistance and continuity as per IS

**Unit VI: Contracts, Tenders and Execution :** Concept of contracts and Tenders Contracts, types of contracts, contractors. Valid Contracts, Contract documents. Tender and tender notices. Procedure for submission and opening tenders. Comparative statements, criteria for selecting contractors, General conditions in order form. Principles of Execution of works Administrative approval, Technical sanctions. Billing of executed work.

**Reference Books:**

1. Electrical Design; Estimating and costing by K.B. Raina, S.K.Bhattacharya New Age International (p) Limited, New Delhi
2. Electrical Estimating and costing by Surjit Singh Dhanpat Rai and company, New Delhi
3. Electrical Estimating and costing by N. Alagappan S. Ekambaram, Tata Mc Graw Hill Publication New Delhi

**FREE ELECTIVE-II**

**6FEEP05/6FEEX 05/6FEEL05/6FEEO5**

**(ii) POWER SUPPLY SYSTEMS**

**SECTION A**

**Unit I:** Structure of Power System – Generation, transmission and distribution. Power generating stations – different types. Steam power stations: Main parts and working, types of boilers and their characteristics. Characteristics of steam turbines and alternators. Main flow circuits of steam power station. Power station auxiliaries, cooling system of alternators. Starting up and shut down procedures of thermal units.

**Unit II:** Gas-turbine power stations- Main parts, plant layout and Bryton cycle operation. Combined cycle generation & Cogeneration. Nuclear power stations- Layout of nuclear power station, types of power reactors, main parts and control of reactors, nuclear waste disposal, radioactivity and hazards.

**Unit III:** Hydroelectric stations: Arrangement and location of hydroelectric stations, principles of working, types of turbines and their characteristics, Pumped storage plants. Coordination of operation of different power stations .

**SECTION - B**

**Unit IV:** Substation - Classification of substations, Major equipments in Substation ,Selection & location of site for substation, Main

Electrical connections, Graphical symbols for various apparatus & circuit elements in substation, connection diagram, Key diagram for typical substation, Busbar layouts. Auxillary supply, substation earthing.

**Unit V:** Power distribution system: Primary and secondary distribution, types of conductors in istribution system, comparison of distribution systems. Distributor design, radial and ring main, current and voltage profiles along a distributor, economics of feeder design.

**Unit VI:** Electrical wiring and installation - Domestic, commercial and industrial wiring, estimation of main, submain and subcircuit wiring. Earthing practice. Testing of installation. Special lighting connections. Conductors, Fuse and disconnecting devices.

**Reference Books:**

1. Powerplant Technology by M.M.El-Wakil, McGraw Hill
2. Power Station Engineering & Economy by B.G.A. Skrotzki & W.A.Vopat, Tata McGraw Hill
3. A Course in Power Plant Engineering, by Arora & Domkundwar, Dhanpat Rai
4. Elements of Electrical Power Station Design, by M.V.Deshpande, Wheeler
5. Electrical Installation Estimating & Costing by J.B.Gupta
6. Transmission & Distribution ,by H.Cotton

**6EP04/6EL04/6EE04 COMPUTERAIDED MACHINE DESIGN**

**SECTION-A**

**Unit I:** Introduction : transformers and three phase induction motors - types, specifications, constructional features, magnetic and insulating materials used; design approaches - analysis, synthesis and hybrid methods; design - variables, constraints and objectives; magnetization, loss and carter's coefficient curves - applications, representation using Piecewise Lineariasation and Least Square Error methods.

**Unit II:** Transformer Design - Magnetic Circuit Specific electric and magnetic loadings selection, output equation, core and yoke cross sections, main dimensions design, core loss from design data.

**Unit III: Transformer Design :**

- A) Electric circuit : Winding types and design, magnetizing current calculation, primary and secondary winding resistances and leakage reactances from design data; mechanical forces - types, causes and calculations.

- B) Thermal circuit cooling methods, Tank wall dimensions design. Design of tank with radiators.

### SECTION-B

- Unit IV:** Induction motor stator design : specific electric and magnetic loadings selection, output equation, main dimensions design, winding - types and design, slot numbers and dimensions design.
- Unit V :** **Induction motor rotor design :** Air gap length design, cage rotor winding design - slot numbers and shapes, bar and ring dimensions; slip ring rotor winding design - slot numbers and shapes, conductors per slot and its cross sections.
- Unit VI: Induction motor parameters :** core loss from design data, magneto motive force calculation - air gap, stator and rotor cores and teeth; no load current - magnetizing and core loss components, stator and rotor winding resistances and leakage reactances from design data, parameters effect on performance.

### BOOKS RECOMMENDED :

1. M.G.Say - The Performance and Design of Alternating Current Machines, C.B.S. Pub. and Distri., Delhi.
2. S.K.Sen - Principles of Electrical Machine Design with Computer Programs, Oxford and I.B.H. Company Pvt. Ltd., New Delhi.
3. S.S.Sastry - Introductory Methods of Numerical Analysis, Prentice Hall of India Pvt. Ltd., New Delhi.
4. R.K.Agrawal : Principles of Electrical Machine Design, S.K.Kataria and Sons, Delhi.
5. Indrijit Dasgupta, Design of Transformers, TMh 1<sup>st</sup> Edition 2002
6. K.G.Upadhyay Design of Electrical Machines, New Age international Publishers, 1<sup>st</sup> Edition 2008

### 6EP06/6EL06/6EE06 ELECTRICAL ENERGY UTILISATION

#### SECTION-A

- Unit I :** Concept of electrical drive, classification, advantages of electrical drive, selection criterion for electrical motor, size, specification and type of motor, mechanical features of motor, transmission of drive, industrial application, general workshop, Textile mill, Paper mill, Cement mill, Coal mining, Sugar mill, Printing industry.
- Unit II:** Types of duties, continues, intermittent and short time, heating and colling of motor, rating calculations for these duties, use of fly wheel and fly wheel calculations. Introduction for conducting and reporting the test on induction motors as per Indian standard.

**Unit III:** Characteristics of DC motors, three-phase induction motors, single-phase induction motors. Quadrantal diagram of speed-torque characteristics of motors, starting methods, different methods of speed control, braking of motors, plugging, rheostatic and regenerative braking.

### SECTION-B

- Unit IV:** Requirement of ideal traction system, system of track electrification and their comparison, speed time curves, energy consumption calculation, calculation of tractive efforts.
- Unit V :** Traction motors, general features and types, characteristics, control of locomotive motor coaches, series-parallel control. Overhead equipments, collector gear for overhead equipments.
- Unit VI:** a) Nature of light-units, luminous efficiency, Glare production of light, Polar curves, control of light by reflection, refraction and diffusion. Lighting calculations, factory lighting, flood lighting, street lighting.  
b) Methods of heating and welding furnaces

### TEXT BOOKS :

- 1) E.O.Taylor : Utilization of Electric Energy in SI Units, published by Orient Longman Ltd.
- 2) S.K.Pillai : A First Course in Electrical Drives, published by New Age International.

### REFERENCE BOOKS :

- 1) Vedam Subrahmanyam : Electric Drives, published by Tata McGraw Hill Publishing Co. Ltd., New Delhi.
- 2) C.L.Wadhwa : Generation Distribution and Utilization of Electrical Energy, published by New Age International Pvt. Ltd.
- 3) Specification of Three Phase Induction Motors as per Indian Standard, published by Indian Standard Institute, New Delhi.
- 4) H.Pratap : Utilization of Electrical Energy.

### 6EX06 POWER ELECTRONICS - I

#### SECTION-A

**Unit I :** SCR, triac, diac-construction, characteristics & applications, two transistor analogy for turning ON-OFF SCR, turn ON mechanism, different methods of turning ON-OFF SCR, turn OFF mechanism, thyristor firing circuits, introduction to GTO, power transistor, power MOSFET & IGBT & their construction & characteristics.

**Unit II:** Series-parallel operation of SCRs, firing ckts. for series and parallel operation, static & dynamic equalising ckts., equalisation of current in parallel connected SCRs, string efficiency, derating factor, protection of SCRs against di/dt, dv/dt, radio freq. interference, over voltage, over current.

**Unit III:** Principle of phase control, half wave controlled rectifier, half controlled bridge & fully controlled bridge rectifier for resistive and RL load, derivation for output voltage and current, effect of free wheeling diode, single phase dual converters.

Three phase half controlled bridge and fully controlled bridge rectifier. (only descriptive approach)

### SECTION-B

**Unit IV:** Classification of ckt. for forced commutation, series inverter, improved series inverter, parallel inverter, out put voltage and waveform control, principle of operation for three phase bridge inverter in 120 deg. and 180 deg. mode, single phase transistorised bridge inverter.

**Unit V:** Basic principles of chopper, time ratio control and current limit control techniques, voltage commutated chopper ckt., Jones chopper, step-up chopper, step-down chopper and AC chopper. Basic principle of cycloconverters, single phase to single phase cycloconverter, voltage regulators.

**Unit VI:** Speed control of DC series motors using chopper, speed control of DC shunt motor using phase controlled rectifiers, speed control of three phase induction motor by stator voltage control, v/f control and slip power recovery scheme. Static ckt. braker, UPS, fan speed regulator, principle of soft start ckts. Zero Voltage Switch.

### TEXT BOOKS :

- 1) Power Electronics - Principles & Applications by Joseph Vithayathil TMH Edition 2010.
- 2) M.H.Rashid : Power Electronics Circuits Devices and Application, PEARSON Education., 3<sup>rd</sup> edition 2004i.
- 3) Principles of Power Electronics, J.G.Kassakian, M.F.SchlechtG.C. Verghese, PEARSON Education 2010
- 4) M.D.Singh & K.B.Khanchandani : Power Electronics, Tata McGraw Hill, New Delhi.

### Reference books :

- 1) Dr.P.S.Bimbhra : Power Electronics, Khanna Publisher, New Delhi.
- 2) P.C.Sen : Power Electronics, TMH Publication Co. Ltd., New Delhi.

- 3) H.C.Rai : Industrial and Power Electronics, Umesh Publication, New Delhi.
- 4) G.K.Dubey, S.R.Doradia, A.Joshi, R.M.Sinha : Thyristorised Power Controllers, New Age International, New Delhi.
- 5) Power Electronics, R.S.Ananda Murthyv. Natarasu, 2<sup>nd</sup> edition,2010

### 6EX07 ELECTRICAL POWER II LAB

Any TEN experiments based on contents of  
6EX03 ELECTRICAL POWER II

### 6EX08 MICRO PROCESSER & MICRO CONTROLLER LAB

Any TEN experiments based on contents of  
6EX04 MICRO PROCESSER & MICRO CONTROLLER

### 6EX09 POWER ELECTRONICS -I LAB

Any TEN experiments based on contents of  
6EX06 POWER ELECTRONICS -I

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### 5EP01/5EL01/5EE01 CONTROL SYSTEM - I

#### SECTION-A

**Unit I:** Introduction to automatic control : open loop and closed loop system, servo-mechanisms, mathematical modeling of physical systems, transfer functionis, block diagrams and signal flow graphs. Effect of feed back on sensitivity to parameter variation and reduction of the noise.

**Unit II:** Control System Components : Electrical / Electro-mechanical components such as A.C./D.C. servomotors, stepper motors, synchors, potentiometers, tachogenerators, their functional analysis and operating characteristics and their application. Pneumatic controls devices.

**Unit III:** Time response analysis : time response of first and second order systems to standard inputs. Time response specifications, types of system, error analysis, error coefficients, steady state errors, dynamic error series. Approximate methods for higher order system, proportional, derivative and integral control.

#### SECTION-B

**Unit IV:** Stability : stability of control systems, characteristics equation, impulse response, Routh-Hurwitz stability criterion, relative stability.

Root Locus : construction of root locus, determination of roots from root locus conditions on variable parameter for stability, effect of addition of poles and zeros.

**Unit V:** Frequency response methods : frequency response of linear system, specification, Logarithmic frequency response (Bode) plots from transfer function for various systems. Polar plots for various systems. Estimation of approximate transfer function from the frequency response.

**Unit VI:** Stability analysis from frequency response : Gain margin and phase margin; Stability analysis from Bode plots. Nyquist criterion, Nyquist plots and stability analysis. Effect of variation of gain, addition of poles and zeros. Relative stability. Stability from gain/phase angle plots.

#### TEXT BOOKS :

1. Control Engineering, D.Ganesh Rao, k.Chennavenkatesh, 2010, PEARSON
2. Modern Control System, Richard Dorf, Robert Bishop, 11<sup>th</sup> edition 2008 PEARSON
3. Nagrath I.J., Gopal M. : Control System Engineering, Wiley Eastern.
4. Ogata K. : Modern Control Systems, Prentice Hall of India.
5. Control Systems by K.R.Varmah TMH edition 2010
6. Control System Engineering, R Anandanatarajan, P Ramesh Babu, SCITECH Publications, Chennai, 2<sup>nd</sup> edition, 2010
7. Automatic Control Systems – Basic Analysis & Design by W.A.Wolovich Oxford University Press, 1<sup>st</sup> edition 2010

### 6 EP01/6EL01/6EE01 ELECTRICAL POWER - I

#### SECTION-A

**Unit I: Transmission line parameters :** calculation of resistance, inductance and capacitance of single phase and three phase transmission lines, skin effect and proximity effect, transposition, G.M.D. & G.M.R. methods, double circuit lines, bundled conductors, effect of earth on inductance and capacitance, interference with communication lines. (10)

**Unit II: Electrical characteristics of transmission line :** V-I characteristics of short, medium and long lines, A, B, C, D constants, nominal  $\pi$  and equivalent T representations, Ferranti effect, corona phenomenon, effect of corona and power loss due to corona.

Representation of power systems : per unit system and one-line reactance diagrams. (10)

**Unit III: Voltage control and power factor improvement :** receiving and sending end power circle diagrams, methods of voltage control and power factor improvement, use of static VAR generators and synchronous phase modifiers, analytical and graphical methods, automatic voltage control. (10)

#### SECTION-B

**Unit IV : Load flow studies :** load flow problem, classification of buses, network modeling, Y-bus and Z-bus matrices, load flow equation, Gauss and NR methods, comparison of methods used. (10)

**Unit V: Mechanical design :** materials used, types of insulators, comparison of pin type and suspension type insulators, voltage distribution and string efficiency, methods of increasing string efficiency, grading rings and arcing horns. Introduction to insulator testing, line supports for LV, HV and EHV, Sag calculation, stringing charts.

**Unit VI : Underground cables :** material used for conductor & insulation : different types of cables and their manufacture, parameters of underground cable, grading of cable losses, break down and rating, testing of cables.

#### Text Books :-

1. Power System Engineering by D.P. Kothari, I.J. Nagrath TMH 2<sup>nd</sup> edition, 9<sup>th</sup> reprint 2010.
2. Power System Analysis, N.V.Ramana, Pearson education, 2010
3. Power System Analysis, Arthur R. Bergen, Vijay Vittal, 2<sup>nd</sup> Edition, 2009, PEARSON Education
4. I. J. Nagrath & D. P. Kothari – “Modern Power System Analysis”, Tata-Mc-Graw Hill Publishing Company, New Delhi.
5. Power System Analysis by Hadi Saadat TMH, 1<sup>st</sup> edition 2011.
6. Electrical Power System, by Syed A. Nasar TMH, Revised 1<sup>st</sup> Edition 2011

#### Reference Books :-

1. S. Rao – “EHV A.C. and HVDC Transmission Engineering and Practice”, Khanna Publishers, New Delhi.
2. Narain G. Hingorani and Lazlo Gyugyi – “Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems.
3. Yong Hua Song and Allan T. Johns - “Flexible AC transmission Systems (FACTS), T and D reference book” Westing house.

### 5 EP02/5EL02/5EE02

#### MICROPROCESSORS & MICROCONTROLLERS

#### SECTION-A

**Unit I:** 8085 : architecture, register structure, addressing modes, instruction set of 8085, timing diagrams.

**Unit II:** Assembly Language Programming of 8085, counters and time delays, stack and subroutines, Memory mapped I/O and I/O mapped I/O, address decoding techniques. Interrupt system of

8085 (software and hardware interrupts). Data transfer schemes, serial data transfer through SOD and SID line.

**Unit III :** Interfacing devices (I) : internal architecture and programming of PPI (8255), PIC (8259), USART (8251).

### SECTION-B

**Unit IV : Interfacing devices (II) :** architecture and programming of programmable interval timer (8253), floppy disc controller (8272), programmable CRT controller (8275), DMA controller (8237). Introduction to architecture 8086.

**Unit V: Microprocessors applications :** hardware & software developments : signal conditioning & data acquisition system components. Measurement of pulse width using parallel port, SID lines, interrupts and timer and counter. Magnitude measurement techniques : rectification, sampling etc. Measurement of fundamental quantities (voltage, current, frequency, speed) and derived quantities (resistance, inductance, capacitance, phase angle, power factor).

**Unit VI: Introduction to microcontroller:** 8051 architecture , 8051 Internal resources, pin diagram, I/O pins, ports and their internal logic circuits, counters, serial ports, interrupt structure, SFRs and their addressing, watch-dog timer, internal code memory, data memory, stack pointer, flags, bit addressable memory, comparative study 8051 families by different manufacturers, study of instruction set of 8051.

### TEXT BOOKS :

- 1) Microprocessor Architecture, Programming, and Applications with the 8085 , Romesh Gaonkar PHI Publication -2006
- 2) Introduction to Microprocessor L.Gibson, Prentice-Hall 2003
- 3) The 8051 Microcontroller Scott MacKenzie Prentice-Hall, Inc -2006

### REFERENCE BOOKS :

1. An Introduction to Microcomputers Volume 1 Basic Concepts, Adam Osborne Osborne-McGraw Hill, Berkely California, 1980
2. The 8051 Family of Microcontrollers Richard Barnett Prentice-Hall, Inc -2005
3. <http://www.nptel.iitm.ac.in/>
4. [www.ocw.mit.edu](http://www.ocw.mit.edu)

**PRACTICALS :** Uniformly distributed Minimum 10 practicals based on above syllabus.

## 6EP03 / 6EL03 / 6EE03 POWER ELECTRONICS

### SECTION-A

**Unit I:** SCR, triac, diac-construction, characteristics & applications, two transistor analogy for turning ON-OFF SCR, turn ON mechanism, different methods of turning ON-OFF SCR, turn OFF mechanism, thyristor firing circuits, introduction to GTO, power transistor, power MOSFET & IGBT & their construction & characteristics.

**Unit II:** Series -parallel operation of SCRs, firing ckts. for series and parallel operation, static & dynamic equalising ckts., equalisation of current in parallel connected SCRs, string efficiency, derating factor, protection of SCRs against di/dt, dv/dt, radio freq. interference, over voltage, over current.

**Unit III:** Principle of phase control, half wave controlled rectifier, half controlled bridge & fully controlled bridge rectifier for resistive and RL load, derivation for output voltage and current, effect of free wheeling diode, single phase dual converters. Three phase half controlled bridge and fully controlled bridge rectifier. (only descriptive approach)

### SECTION-B

**Unit IV:** Classification of ckt. for forced commutation, series inverter, improved series inverter, parallel inverter, out put voltage and waveform control, principle of operation for three phase bridge inverter in 120 deg. and 180 deg. mode, single phase transistorised bridge inverter.

**Unit V:** Basic principles of chopper, time ratio control and current limit control techniques, voltage commutated chopper ckt., Jones chopper, step-up chopper, step-down chopper and AC chopper. Basic principle of cycloconverters, single phase to single phase cycloconverter, voltage regulators.

**Unit VI:** Speed control of DC series motors using chopper, speed control of DC shunt motor using phase controlled rectifiers, speed control of three phase induction motor by stator voltage control, v/f control and slip power recovery scheme. Static ckt. braker, UPS, fan speed regulator, principle of soft start ckts. Zero Voltage Switch.

### TEXT BOOKS :

- 1) Power Electronics - Principles & Applications by Joseph Vithayathil TMH Edition 2010.
- 2) M.H.Rashid : Power Electronics Circuits Devices and Application, PEARSON Education., 3<sup>rd</sup> edition 2004i.

- 3) Principles of Power Electronics, J.G.Kassakian, M.F.SchlechtG.C. Verghese, PEARSON Education 2010
- 4) M.D.Singh & K.B.Khanchandani : Power Electronics, Tata McGraw Hill, New Delhi.

**Reference books :**

- 1) Dr.P.S.Bimbhra : Power Electronics, Khanna Publisher, New Delhi.
- 2) P.C.Sen : Power Electronics, TMH Publication Co. Ltd., New Delhi.
- 3) H.C.Rai : Industrial and Power Electronics, Umesh Publication, New Delhi.
- 4) G.K.Dubey, S.R.Doradia, A.Joshi, R.M.Sinha : Thyristered Power Controllers, New Age International, New Delhi.
- 5) Power Electronics, R.S.Ananda Murthyv. Natarasu, 2<sup>nd</sup> edition,2010

**5EP07 / 5EL07 / 5EE07 CONTROL SYSTEM - I - LAB.**

Any TEN experiments based on contents of  
5EP01/5EL01/5EE01 CONTROL SYSTEM - I

**6EP07 POWER ELECTRONICS - I - LAB**

Any TEN experiments based on contents of  
6EP03/6EL03/6EE03 POWER ELECTRONICS

**6EP08/6EL08/6EE08 COMPUTERAIDED MACHINE DESIGN - LAB**

Any TEN experiments based on contents of  
6EP04/6EL04/6EE04 ELECTRICAL MACHINES - II

**6EP09 ELECTRICAL ENERGY UTILIZATION - LAB**

Any TEN experiments based on contents of  
6EP06/6EL06/6EE06 ELECTRICAL ENERGY UTILIZATION

**DRAFT SYLLABUS PRESCRIBED FOR  
BACHELOR OF ENGINEERING  
(INFORMATION TECHNOLOGY)**

**SIT01 OPERATING SYSTEMS**

**Unit-I: Introduction:** Operating System(OS) definition, OS Evolution, OS Components and Services. Process Concept, Process Scheduling, Operations on Processes, Cooperating Processes, Interprocess Communication, Threads Overview, Multithreading Models, Threading Issues, Java Threads.

**Unit-II:** CPU Scheduling Concepts, Scheduling Criteria and Algorithms. Process Synchronization: The Critical-Section Problem, Synchronization Hardware, Semaphores, Monitors. Deadlocks: Definition & Characterization, Deadlocks Prevention, Avoidance, Detection and Recovery from Deadlock.

**Unit-III:** Memory Management Background, Swapping, Contiguous Memory Allocation Schemes, Paging, Segmentation. Virtual Memory Management: Background, Demand Paging scheme, Process Creation, Page Replacement Policies, Allocation of Frames, Thrashing.

**Unit-IV:** File-System Interface; Directory Structure, File-System Mounting, File Sharing & Protection. File- System Structure, File-System Implementation. Directory Implementation, Allocation Methods, Free-Space Management. File Recovery.

**Unit-V:** I/O Systems : Overview, I/O Hardware, Application I/O Interface, and Kernel I/O Subsystem. Transforming I/O to Hardware Operations. Disk Scheduling, Disk Management, Swap-Space Management, RAID Structure.

**Unit-VI:** The Linux System; History, Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, File Systems, Input and Output, Interprocess Communication, Network Structure & Security in Linux.

**Text Book:**

Avi Silberschatz , P.B.Galvin, G. Gagne: "Operating System Concepts" (Sixth Edition) John Wiley & Sons Publication.

**Reference Books :**

1. A.S Tanenbaum "Modern Operating Systems" Pearson Education.
2. William Stallings "Operating Systems" Prentice-Hall.
3. D M Dhamdhare "Operating Systems" Tata McGraw-Hill.
4. M Milankovic "Operating Systems" McGraw-Hill."



**5IT06 Operating Systems Lab:**

Minimum 8 experiments based on the syllabus of 5IT01.

**5IT02 DIGITAL INTEGRATED CIRCUITS**

**Unit-I: Digital Integrated Circuits:** Special characteristics like fan-out, power dissipation, propagation delay & noise margin. Bipolar transistor characteristics. TTL and CMOS families. Simplification of Boolean functions: the K-Map method, two- & three-Variable maps, four-variable map, five-variable map. Tabulation method. Determination of prime implicants. Selection of Prime implicants.

**Unit-II: Combinational Logic:** introduction. design procedure. adders. subtractors. code conversion. analysis procedure. Multilevel NAND circuits : universal gate, Boolean-function implementation. Multilevel NOR circuits: universal gate, Boolean-function implementation. Exclusive-OR functions. Odd function. Parity generation & checking.

**Unit-III: MSI & PLD components:** introduction. Binary parallel adder, magnitude comparator, decoders & encoders. multiplexers. ROM. Various types of ROM. Programmable Logic Arrays. Programmable Array Logic – PAL, PLA & ROM

**Unit-IV: Synchronous Sequential circuits:** introduction, Flip-Flops: basic circuits, RS-, D-, JK- & T- Flip-Flops. Triggering of flip flops. Analysis of clocked sequential circuits. State reduction & assignment. Flip-flop excitation table. Design procedure. Design of counters: ripple counters, synchronous counters.

**Unit-V:** Design of Registers & shift registers. Random access memory (RAM). Memory decoding techniques. Hamming code. Algorithmic State Machines: introduction, ASM chart, timing considerations. Control implementation. Design with multiplexers. PLA control.

**Unit-VI: Fault detection and location in combinational circuits:** Path – Sensitizing method, Equivalent normal form method, Two level fault detection. Fault detection and location in sequential circuits: Circuit test approach, initial state identification, final state identification.

**Text-Book :**

1. Charles H. Roth, “Fundamentals of Logic Design” (JPH)
2. Samuel C. Lee, “ Digital circuits and Logic Design (PHI)

**Reference Books:**

1. M. Morris Mano “Digital Design” (2/e) (PHI).

2. Taub & Schilling “ Digital Integrated Electronics” (TMH).

3. Jain R.P. “Modern Digital Electronics” (TMH).

4. Fletcher W.I. “An Engineering Approach to Digital Design” (PHI).

**5IT07 Digital Integrated Circuits Lab :**

Minimum 08 experiments based on the 5IT02 syllabus, two experiments on each unit. Chapter 11 “Laboratory Experiments” of the text- book: M. Morris Mano “Digital Design” (2/ e) (PHI), may be referred for guidelines to setup laboratory sessions.

**5IT03 COMPUTER ARCHITECTURE & ORGANIZATION**

**Unit-I: Basic structure of computer:** Hardware & software. Addressing methods. Program sequencing. concept of memory locations & address. Main memory operation. Instructions & instruction sequencing. Addressing modes. Basic I/O operations. Stacks. Queues & subroutines.

**Unit-II: Processing Unit:** fundamental concepts. execution of a complete instruction. hardwired control, performance consideration. Microprogrammed control; microinstructions, microprogram sequencing, microinstruction prefetching, emulation.

**Unit-III: I/O organization:** accessing I/O devices, interrupts, direct memory access: bus arbitration. I/O hardware: processor bus and interfacing circuits, standard I/O interfaces: SCSI bus, backplane bus standard.

**Unit-IV: Memory Unit:** basic concepts, semiconductor RAM memories, internal organization, static & dynamic RAMs, ROMs. speed, size & cost considerations. Cache memories: performance considerations. Virtual memories, address translation, memory management requirements.

**Unit-V :** Arithmetic; number representation. design of fast adders, signed addition and subtraction. Multiplication of positive numbers, Booths’ algorithm, Integer division. Floating-point numbers and related operations.

**Unit-VI: Computer Peripherals:** Input-output devices like video displays, video terminals, graphics input devices, printers. Online storage devices: magnetic disks, magnetic tape systems, CD-ROM systems. Communication devices: Modems.

**Text-Book:**

V. Carl Hamacher & S. Zaky “ Computer Organization” (4/e) McGraw-Hill (ISE).

**Reference Books:**

1. Stallings. W. "Computer Organization & Architecture" (5/e) (Pearson Education).
2. Tenenbaum A.S." Structured Computer Organization" (5/e) (Pearson Education).
3. Hayes J.P." computer Architecture & Organization' (4/e) ( McGraw-Hill).
4. Mano M. & Kime "Logic & Computer Design Fundamentals" (2/e) (Pearson Education).

**5 IT04 COMMUNICATION SKILLS****Unit I :** Comprehension over an unseen passage.

Comprehension - A - word study :- Synonym, antonym, meanings, matching words, adjectives, adverbs, prefix and suffix, correct forms of commonly misspelled words, understanding of the given passage, reading

Comprehension - B - Structure study :- Simple and compound sentences, types of conjunctions, singular and plural, tenses and their effect on verb forms. Use of - not only - but also, if clause, since, may, can, could, would, too etc.

Active and passive forms, negative and interrogative, punctuation and capitalization. Summary, Precise & abstract writing. (10 Hours)

**Unit II:** Theoretical background - importance of communication, its process, model of communication its components & barriers. Verbal communication, its significance, types of written communication, organization of a text (Titles, summaries, headings, sequencing, signaling, cueing etc.), Important text factors (length of paragraph, sentences, words, clarification and text difficulty). Evaluation of written communication for its effectivity and subject content.

Non-verbal communication, types of graphics and pictorial devices. (10 Hours)

**Unit III:** Specific formats for written communication like – business correspondence, formal reports, technical proposals, research papers and articles, advertising and graphics. Format for day-to-day written communication like writing applications, Resume, notices, minutes, quotations, orders, enquiries etc. Claim letter. Oral communications - Important objectives of interpersonal skills, soft skills(listening, speaking strategy), (verbal and non-verbal), face to face communications, group discussion and personal interviews.

Methodology of conduction of meetings, seminars, symposia, conference and workshop. (10 Hours)

**BOOKS RECOMMENDED :**

- 1) Krishna Mohan, Meera Banerjee : Developing Communication Skills, MacMillan India Limited.
- 2) M.A. Rizvi: Effective Technical communication, Tata McGraw Hill.
- 3) Urmila Rai & S.M.Rai : Communication Skills ,Himalaya Publisher House.
- 4) Chrissie Wright (Editor) : Handbook of Practical Communication Skills, Jaico Publishing House.
- 5) Dr. Nageshwar Rao & Dr. Rajendra P. Das : Communication skills, Himalaya Publisher House.

**FREEELECTIVE-I****5FEIT05 (i) INTRODUCTION TO COMPUTER NETWORKS**

**Unit -I :** Introduction to Computer Networks, Network Topologies, Ethernet LAN, assembling a Home Network and office LAN, Analyzing Computer Networks, Physical Layer Cabling: Twisted Pair, Structural Cabling, UTP Cable, terminating CAT6/5E/5UTP cables.

**Unit II :** Computer Fundamentals, Computer Bus connection, Device Drivers, Computer Memory, Overview of FAT and NTFS, configuring the BIOS boot sequence.

**Unit III :** Interconnecting the LAN, OSI Model, network bridge, switch, Router, Interconnecting LANs with the Router. configuring the network interface-Auto-negotiation.

**Unit IV :** TCP/IP : Layers, number conversion, IPV4 Addressing, subnet masks, CIDR blocks, IPV6 Addressing, Analyzing computer networks-FTP data packets.

**Unit V :** Router Configuration, Introduction, Router fundamentals, the console port connection the routers use EXEC Mode, routers privileged EXEC mode, troubleshooting the router interface

**Unit VI :** Routing protocols: Static routing, Dynamic routing protocols, RIP, IGRP, OSPF, EIGRP, TFTP, analysing OSPF "hello" packets.

**Text Book :**

Jeffrey S. Beasley, "Networking" second edition. Pearson

**Reference Books :**

1. Bhushan Trivedi, "Computer Networks" OXFORD.
2. Andrew S. Tanenbaum, "Computer Networks" IV edition Pearson
3. Youlu Zheng, Shakil Akhtar, "Networks for computer Scientists and Engineers" OXFORD.

**FREELECTIVE-I****5FEIT05 (ii) IT ETHICS & PRACTICES**

- Unit I :** An overview of Ethics, Ethics in business world, Ethics in IT, Ethics for IT professionals and IT users, IT professionals, Ethical behaviour, IT professional malpractices, IT users.
- Unit II :** Computer and Internet Crime : IT security incidents : Increasing Complexity INcreases Vulnerabiligy, Higher Computer user Expectations, Expanding and changing systems. INtroduces new risks,Increased Reliance on Comercial Software with known Vulnerabilites, Types of Attacks, Perpetrators, Reducing Vulnerabilites, Risk Assessment, Establishing a Security Policy, Educating Employees, contractors and part-time Workers, Prevention, Detection, Response.
- Unit III :** Privacy: The right of Privacy, Recent History of Privacy Protection, Key Privacy and Anonimity issues, Governmental Electronic Surveillance, Data Encryption, Identity Theft, Consumer Profiling, Treating Consumer Data Responsibility, Workplace Monitoring, Spamming, Advancd surveylance Technology, First Amendment Rights, Obsence Speech, Defamation, Freedom of Exprssion : Key issues, Controlling Access to Information on the INternet, **Antronimity, National, Security Letters, Defamation and Hate Speech.**
- Unit IV :** Intellectual Property: Copyrights, Patents, Trade Secret Laws, Key Intelectual Property Issues, Plagiarism, Reverse Engineering, Open Source Code, Competitive Intelligence, Cybersquatting, Software Development, Strategies to Engineer Quality Software, The Importance of Software Quality, Software Development Process, Capability, maturity Model Integration for Software, Key isues in Software Development, Development of Safety-Critical Systems,Quality Management Standards.
- Unit V :** Employer/Employees Issues, Use of Nontraditional Woekrs, Contigent Workers H-IB Workrrs, Whistle-blowing, Prtotetion for Whistle-Blowers, Dealing with Whistle-Blowing Situation.
- Unit VI :** The impact of Information, Technology on the Quality of Life, The inmpact of IT on the standard of Living and productivity, theDigital Divide, The impact of ITon Health care costs, Electronic Health Records, Use of Mobile andWireless Technology, Telemedicine.  
Medical INformation Wet Sites for lay people.  
ACM, AITP Association of INformation Technology Code of Ethics and Professional Conduct, Profesionals Code of Ethics, Softwar Engineering Code of Ethics and Professional Practice, PMI Member Ethical Stnadards and Member code of Ethics.

**Text Book :**

Geroge Raynolds, "Ethics in information Technology" Cengage Learning

**Reference Books :**

1. Deborah G.Johnson,"Computer Ethics",3/e Persiaon Education.
2. Sara Baase, "A Gift of Fire: Social, Legal and Ethical Issues, for Computing and the Internet," PHI publications
3. Richard A.Spinello, "Case study in INformation Technology Ethics", second Edition PHI
4. Duncan Lanford " Intenet Ethics".
5. D.Micah Hester and Paul J. Ford "Computer and Ethics in the Cyberage".

**5IT08 COMMUNICATION SKILLS LAB:****Lab based on syllabus of 5IT08.**

**Objective:** On completion of this laboratory the candidate should be able to demonstrate adequate skills in oral and written communication for technical English language actively participate in group discussions and interviews and exhibit the evidence of vocabulary building. Candidates should be accessed through continuous monitoring and evaluation. The sample list of experiments is given below. This list can be used as guideline for problem statements but the scope of the laboratory should not be limited to the same. Aim of the list is to inform about minimum expected outcomes.

1. Assignments and tests for vocabulary building
2. Technical report writing
3. Group discussions
4. Interview techniques
5. Projects and tasks such as class news letter
6. Writing daily diaries and letters
7. Interactive language laboratory experiments.

**Test Book:** Norman Lewis: Word Power Made Easy

**5IT09 COMPUTER LAB- III (VC++)**

This laboratory shall be based on MFC using VC++. Minimum eight programs based on the following:

- i) MFC application creation
- ii) Using dialog boxes
- iii) Windows common controls
- iv) Document / View architecture
- v) Printing with MFC

**Reference :** J. Prosis: Programming Windows with MFC (Microsoft Press).

### 6IT01 PRINCIPLES OF MANAGEMENT

- Unit I: Introduction:** Definition and concepts of management, Importance of management. Various management functions & control, responsibilities. Human resources planning, Decision-making, Trade unions & collective bargaining.
- Unit II :Organization planning, design and development:** Production resources, Production planning, types of production system, production systems, production control.
- Unit III:** Product design & development: Introduction, design of the product, New product development; Material planning and control. Inventory control technique.
- Unit IV: Maintenance and system reliability:** Concepts and Objectives of maintenance. Failure analysis, Reliability Maintenance system & Classification. Maintenance planning, TQM ISO 9000 and Quality audit.
- Unit V: Marketing management:** Introduction, marketing planning. Consumer behavior, product management, Pricing & promotion decision. Financial planning. Source of finance.
- Unit VI:** Project Management: Concepts and importance of project, Project implementation, MIS.MIS meaning and objectives. Types of data, methods of data collection, analysis and presentation of data. Editing, reporting and presentation of data, Decision options.

#### Text Book:

A.K.Gupta, J.K. Sharma: Management of Systems (Macmillan)

#### Reference Books:

1. Appleby: Modern Business Administration, 6/e (Macmillan)
2. Tritaphy & Reddy: Principals of Management, 2/e (TMH)
3. Gupta, Sharma et : Principales of Practices of Management (Kalyani)

### 6IT02 DATABASE MANAGEMENT SYSTEMS

- Unit I:** Database System Applications, Database Systems versus File Systems, View of Data, Data Models, Database Languages, Database Users and Administrators, Transaction Management, Database System Structure, Application architectures, History of Database Systems. Entity-Relationship Model, Basic Concepts, Constraints, Keys, Design Issues, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R Features, Design of an E-R Database Schema, Reduction of an E-R Schema to Tables.

- Unit II : Relational Model:** Structure of Relational Databases, The Relational Algebra, Extended Relational-Algebra Operations, Modification of the Database, Views, The Tuple Relational Calculus, The Domain Relational Calculus, SQL: Basic Structure, Set Operations, Aggregate Functions, Null Values, Nested Sub queries, Views.
- Unit-III:** Integrity and Security, Domain Constraints, Referential Integrity, Assertions, Triggers, Security and Authorization, Authorization in SQL, Encryption and Authentication, Relational-Database Design:, First Normal Form, Pitfalls in Relational-Database, Design, Functional Dependencies, Decomposition, BCNF, Third, Fourth and more Normal Forms, Overall Database Design Process.
- Unit-IV: Query Processing:** Overview, Measures of Query Cost, Selection Operation, Sorting, Join Operation, Other Operations, Evaluation of Expressions, Query Optimization: Overview, Estimating Statistics of Expression Results, Transformation of Relational Expressions, Choice of Evaluation Plans, Materialized Views.
- Unit-V: Transaction Management :** Transaction Concept, Transaction State, Implementation of Atomicity and Durability, Concurrent Execution, Serializability, Recoverability, Implementation of Isolation, Transaction Definition in SQL, Testing for Serializability.
- Unit-VI: Concurrency Control:** Lock-Based Protocols, Timestamp-Based Protocols, Validation-Based Protocols, Multiple Granularities, Multiversion Schemes, Deadlock Handling, Insert and Delete Operations Weak Levels of Consistency, Concurrency in Index Structures. Recovery System, issues & solutions.

#### Text Book:

Korth, Sudarshan : Database System Concept , Mc Graw Hill, 4th Edition

#### Reference Books :

1. Raghu Ramkrishnan :Database system
2. C.J.Date : Database System, 7th ed.
3. Connolly & Begg, : Database System,Low Price Ed.

### 6IT 03 THEORY OF COMPUTATION

- Unit I:** Alphabet, Language, Operations, Finite state machine, definitions, Finite automation model, Acceptance of strings and languages. Non deterministic finite automation, deterministic finite automatiioni, equivalence between NFA and DFA. Conversion of NFA into DFA, minimisation of FSM, equivalence between two FSM's, Moore and Melay machines.

**Unit II:** Regular sets, regular expressions, identity rules. Manipulation of regular expressions, equivalence between RE and FA. Inter conversion, pumping lemma, Closure properties of regular sets (proofs not required), Regular grammars, right linear and left linear grammars, equivalence between regular linear grammar and FA inter conversion between RE and RG.

**Unit III:** Context free grammar, derivation trees, Chomsky normal form, Greibach normal form, push down automata, definition, model, acceptance of CFL, equivalence of CFL and PDA, interconversion, enumeration of properties of CFL (proofs omitted)

**Unit IV:** Turing machine, definition, model, design of TM, computable functions, recursive enumerable language, Church's hypothesis, counter machine, types of TM's.

**Unit V:** Chomsky hierarchy of languages, linear bounded automata and context sensitive language, introduction of DCFL and DPDA, LR (O), grammar, decidability of problems.

**Unit VI: Undecidability :** properties of recursive & non-recursive enumerable languages, universal turing machine, postcorrespondance problem, introduction to recursive function theory.

#### Text Books :

1. Introduction to Automata Theory, Languages and Computation by Hopcraft H.E. & Ullman J.
2. An Introduction to Formal Languages and Automata by Peter Linz (Chapter 1 to 12 except 6.3 & 7.4)

#### Reference books :

1. Introduction to Languages and the Theory of Automata by John C.Martin.
2. Elements of Theory of Computation by Lewis H.P. and Papadimitriou C.H.
3. Theory of Computation by Mishra & Chandrashekharan.

### 6IT04 COMPUTER NETWORKS

**Unit I: Introduction to Computer network,** Uses, Hardware, Software, reference Model, standardization, Physical Layer, Theoretical Basis for DC, Guided transmission Media, Wireless Transmission, communication satellite, Public Switched Telephone Network, Mobile Telephone System, Cable Television.

**Unit II: Data Link Layers :** Design issues , , Error detection and correction, Elementary Data Link protocols, Sliding window Protocols, Protocol Verification, Example DL protocols.

**Unit III: MAC Sublayer :** Static and Dynamic channel allocation, Multiple Access protocols, ALHOA, CSMA, Collision Free Protocols, Ethernet, Wireless LANs, Broadband Wireless, Blue tooth, Data Link Layer Switching.

**Unit IV: Network Layer:** Design Issues, Routing methods: Shortest path, flooding, Link state, Distance vector routing and broadcast & multicast routing, Congestion control algorithms, quality of services , internet working, network layer in the Internet .

**Unit V : The Transport Layer :** Service primitives, UDP: RPC, RTTP, TCP: TCP Services and Features, TCP segment format, TCP Connections, TCP Timers, performance issue.

**Unit VI: The Application Layer:** DNS, Electronic Mail, WWW, Multimedia: Voice over IP, H.323, Video on demand, The M-Bone.

#### Textbook :

- 1: Andrew S. Tanenbaum : Computer Networks , Fourth Edition, – (Pearson)

#### Reference Books :

1. James F. Kurose & K W Ross: Computer Networking Pearson Education (LPE)
2. Douglas E. Comer: Computer Network & Internet Addison Wesley.
3. Leon Garcia & Widjaja: Communication Networks TMH
4. William Stallings: Data & Computer Communication Pearson Education

### FREEELECTIVE-II 6FEIT05 (i) E-COMMERCE

**Unit I:** E Commerce : The difference between E-commerce and E-business, Why study E-commerce? Eight unique features of E-Commerce Technology, Types of E-Commerce, Growth of the INternet and the WEB, Origins and Growth of E-commerce, E-Commerce - A brief History.

**Unit II:** E-commerce Business Models and Concepts : E-Commerce business Model-eigh Key elements of a Business Model, Major Business-to-Consumer (B2C) Business Models, Major Business to -Business (B2B) Business Models: Business Models emerging in E-Commer areas, How the INternet and the WEB change Business; Strategy, Structure and Process.

- Unit III:** E-Commerce Infrastructure : The Internet: TEchnology Background, The Intenet Today, Intenet II; The future infrastructure,The World Wibe WEB, The Intenetand the Web Featurs.
- Unit IV:** Building an E-Commerce Web Site : Building and E-Commerce Wet Site- A strategic approach, Choosing Server Software, Choosing the Hardware for an E-Commerce site, Ohter E-Commerce Site Tools.
- Unit V:** Online Security and payment systems :The E-Commerce Security Environment, Security threads in the E-commerce environment, Technology solutions,Management Policies, business procedures and public laws, payment systems.
- Unit VI:** E-Commerce Marketing Concepts : Cosumer online; The INternet Audience and Consumer behaviour, Basic Marketing Concepts, INtrnet Marketing Technologies, B2C and B2C E=Commerce marketing and Branding strategies.

**Text Book :**

KenethC. Laudon, Carol Gurcio Trave”e-commerce, business, technology, society” (Pearson)

**References:**

1. Dave Chaffley “E-Business and E-commerce management”(3<sup>rd</sup> Edition) Pearson.
2. Kalkakofa Whirttoton, “Frontiers of E-Commerce” Pearson.

**FREELECTIVE-II****6FEIT05 (ii) KNOWLEDGE MANAGEMENT**

- Unit I:** Importance and knowledge management, key assumptions, The knowledges society conkcept and critical evaluation, objectivist perspectives on knowledge, The knowledge-based theory of the firm, typolist of knowledge, an objectivist perspectivest on sharing nd management of knowledge, features of practice-based perspective, implications for nature of the organizational knowledge base, a practice-based perspective.
- Unit II:** KNowledge management, what is manaement, knowledge management and busines strategy, conceptulasing the divesity of knowledge management strategies, The rises and defining knowledge worker, knowledge work and ambiguity, knowledge process in knowledge, insensive frims contrasting, perspective, learing and knowledge management, the heterogeity of learing, dynamics of organizational learning, the learning organizaion.
- Unit III:** Characterising innovation, process, innovation as an interactive process, knowledge creation and Nonaka, the social dynamic

of innovation networking process, Conceptulizing organiztinal forgetting, barriers to unlearning.

- Unit IV:** The share/horad dinemma, the context of the employment relationship, the ubiquity of conflict in business organizations and its impact, inter-personal trust, group identity, personality, communities of practice
- Unit V:** The significance and Characterilising cross community of knowledge process, identity, knowledge, trust and social relatinas, a classlfication of boundary types, facilitating/managing knowledge between communities, to perspectives on power and the power/knowledge relationship,power and the resources nd the critical discourse on knowledge management,power/knowledge and the dialogical discourse on knowlege management
- Unit VI:** linking knowledge management ICTs, objectives visit and practice-based perpseptcies on ICT, the importance of accounting for socio-cultural factors in ICT,debates regarding the role of ICTs in knowledge management process, why cultural management and HRM practice are importance to knowledge management, the knowledge management, HRM, staff retention, Leadership and knowledge management.

**Text Book :**

Donld Hislob-”Knowledge Management in Organizations”(Oxford)

**Reference Book :**

B.Muthukumaran-”Information Technology for Management” (Oxford)

**6IT07 COMPUTER NETWORKS LAB:**

Minimum 8 experiments/ Computer Programming based on the syllabus of 6IT04.

**6IT08 Computer Lab-IV (UML):** Sample practical’s list :

Study of basic notations of all types of UML diagrams.

- 1) Design state diagram for telephone system?
- 2) Design the use-case diagram for bank management system, having deposit & withdraw is use case & clerk & customer is actor (assume other parameter).
- 3) Design an object & class diagram for company as class & various department & employee as an object.
- 4) Design the activity diagram for library system and prepare a plan.
- 5) Design a sequence diagram for online shopping & explain in details.

- 6) Design a component diagram for building a house.
- 7) Design a collaboration diagram for hospital management system

**References Books :**

- 1) The Unified Modelling Language User Guide:Grady Booch, James Rumbaugh, Ivar Jacobson
- 2) The Unified Modelling Language Reference Manual:Grady Booch, James Rumbaugh, Ivar Jacobson

**6IT06 DATABASE MANAGEMENT SYSTEMS LABORATORY**

The sample list of programs based on ORACLE or MY SQL is given below. This list can be used as guideline for problem statements but the scope of the laboratory should not be limited to the same. Aim of the list is to inform about minimum expected outcomes.

1. Consider the employee database, where the primary keys are underlined & Write the Queries using following clauses & also retrieve the data from the given database.  
Employee (employee-name,street,city)  
Works (employee-name,company-name,salary)  
Company (company-name,city)  
Manages(employee-name,manager-name)  
I) Order By II) Between III) Group By IV) Having
2. Consider the above database & perform the different Join Operations which are as follows.  
I) Inner Join II) Left Outer Join  
III) Right Outer Join IV) Full Outer Join
3. Consider the above database & Perform the different Set Operations Which are as follows.  
I) Union II) Intersect III) Except/Minus
4. Consider the above database & perform the all Aggregate Functions.
5. Write an assertion for the bank database to ensure that the assets value for the 'perryridge' branch is equal to the sum of all amounts lent by the 'perryridge' branch.  
Customer(customer-name, customer-street, customer-city)  
Branch(branch-name, branch-city, asstes)  
Loan(loan-number,branch-name,amount)  
Borrower(customer-name,loan-number)  
Depositor(customer-name, account-number)  
Account(account-number,branch-name,balance)
6. Write an SQL trigger to carry out the following action: On delete of an account, for each owner of the account, check if the owner

has any remaining accounts, and if she does not, delete her from the depositor relation.

7. Consider the above Bank database & write the SQL queries for the following views:
  - I) A view containing the account numbers the customer names for all accounts at the deer park branch.
  - II) A view containing the names and addresses of all customers who have an account with the bank, but do not have a loan.
8. Mini Project Using Oracle 9i & VB6

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**SYLLABUS PRESCRIBED FOR  
FIVE YEAR DEGREE COURSE IN  
ARCHITECTURE  
SEMESTER PATTERN (CREDIT GRADE SYSTEM)  
FIFTH & SIXTH SEMESTER**

**SEMESTER: FIFTH  
05AR01 & 05AR07**

**BUILDING MATERIALS & CONSTRUCTION-V**

**Objective :** The course will enable the learning in progression , starting from simple building elements, components, materials and construction techniques to develop strong sense of visualization.

**Unit I:** Structural steel members with connections of girders, stanchions and grillage foundations.

**Unit II:** R.C.C frame structures and advantages over load bearing masonry constructions. Detailing of R.C.C. work with reinforcement for one way & two way slabs, R.C.C. beams , columns, footings and its types. Flat plate slab and its purpose.

**Unit III:** R.C.C. cantilevers and reinforcement details in chajjas, balcony, canopy, lofts, etc. R.C.C. staircases and its reinforcement details.

**Unit IV:** Shallow foundations and its types. Detail study of raft foundations , its types and uses.

**Unit V:** Appropriate cost effective construction techniques and materials to be useful to conserve energy.

**Unit VI:** Special concrete and concreting methods such as light weight, high density, fibre reinforced, polymer concrete- outline of manufacture, properties and uses. Ready mix concrete and current developments in concrete product.

**Sessional work:** Assignments, test, site visit and drawing on the above topics.

**References:**

1. S.C. Rangwala, Engineering Materials, Charotar Publishing House, Anand, 1997
2. HUDCO - All you want to know about soil stabilized mud blocks, HUDCO Pub, New, Delhi, 1989.
3. W.B. McKay Building Construction, vol. 1,2,3, Longmans, U.K. 1981.

4. Don A Watson, Construction Materials and Processes, McGraw Hill Co., 1972.
5. R. Chudley, Construction technology, Richard Clay (Chaucer Press) Ltd., Suffolk, 1978.
6. J.H. Callender, Time saver standard for Architectural Design Data, McGraw-Hill, 1994.

**05AR02 BUILDING SERVICES AND EQUIPMENTS.**

**Objective:** To impart knowledge of various aspects of water supply systems, drainage and solid waste disposal from building.

**Unit I:** General ideas of types of water impurities. Systems of water supply of low rise buildings and high rise buildings.

**Unit II:** Computing water demands for various uses - hot water supply system- solar water heater- geysers.

**Unit III:** Water supply pipes and fittings, material, size and classifications. Types of taps , toilet and kitchen fittings.

**Unit IV:** Water storage reservoir, their types and importance in water supply scheme.  
Electrical wiring systems and electrical appliances.

**Unit V:** Drainage systems, conservancy and water carriage systems. Types of traps and sanitary fittings.

**Unit VI:** Sewage disposal systems from building.

**Sessional work:** Assignments, test, site visit and drawings on the above topics.

**References:**

1. Manual of Water supply and treatment , second edition, CPHEEO, Ministry of Works and housing, New Delhi, 1977.
2. Manual of Sewerage and sewage treatment, CPHEEO Ministry of Works and housing, New Delhi, 1980.
3. S.C. Rangwala, water supply and sanitary Engineering, Charotar publishing House , Anand 1989.

**05AR03 ARCHITECTURAL STRUCTURE-IV.**

**Objective:** Understanding of Basic Theory and principles of structural analysis and structural properties of elements.

**Unit I:** Concrete technology- types of cements, fine and coarse aggregates, water cement ratio, formwork (visit to construction sites).



**Unit II:** Mild steel and tor steel reinforcement , bending and fixing, placing of concrete and methods of compacting , expansions and constructions joints in concrete, durability of concrete with respect to honeycomb free, cold joint, role of admixtures in concrete.

**Unit III:** Use of I.S. Code for R.C.C. member, I.S.456, I.S.800, I.S.875.

**Unit IV :** R.C.C. theory - Introduction to limit state method.

**Unit V :** Column, beam and slab design in limit state method.

**Unit VI:** R.C.C. footing and staircases design by limit state method.

**Sessional work:** Assignments and tutorials on the above topics.

**References:**

1. P.C.Punmia, Strength of Materials and Theory of Structures; vol I, Laxmi Publications, Delhi 1994.
2. S.Ramanmurtham, Strength of Materials – Dhanpatrai & Sons, Delhi 1990
3. W.A.Nash, Strength of Materials – Schaums Series – McGraw Hill Book Company, 1989
4. R.K.Bansal – engineering Mechanics and Strength of Materials – Lakshmi Publications, Delhi, 1990

**05AR04 SPECIFICATION**

**Objective:** To impart knowledge of specification of materials and its importance.

**Unit I:** Art of writing specifications of material along with emphasis on the quality of the materials and proper sequence of construction works.

**Unit II:** Importance of specification in the building activities, method of writing correct order and sequence of use of materials. Use of Indian Standard specification and P.W.D. specification.

**Unit III:** Primary considerations for selections of materials for various operations .

**Unit IV:** Specifications of basic materials required in residential buildings such as bricks, concrete, r.c.c., plastering, various finishes, timber work, flooring materials, glazing, metals, etc.

**Unit V:** Specification of works for residential building- load bearing masonry type and R.C.C. framed type, steel structures, ceiling and partitions, paneling , insulation and waterproofing. Specification for services such as drainage, water supply, electrical installation.

**Unit VI:** Specifications for demolitions work , temporary constructions like sheds, exhibition stalls, gateways etc.Study of proprietary building materials along with manufactures specifications, trade name of such materials.

**Sessional work:** Assignments, tests, and tutorials on the above topics

**References:**

1. W.H.King and D.M.R.Esson, Specification and quantities for Civil Engineers, The English university Press Ltd.
2. P.W.D. Standard specifications, Govt. Publications.
3. Dutta, Estimating and Costing, S. Dutta and Co., Lucknow.

**05FEAR05 FREE ELECTIVE**

**(1) FUNDAMENTALS OF ARCHITECTURAL DESIGN**

**Objective:** The prime objective of this course is to introduce architectural design as a process and as a final product , to understand fundamentals of space, form and order through basic perception of architectural skills.

**Unit I:** Introduction to Architecture. Definition of Architecture, design art, fine art, visual art.

**Unit II:** Principles of two dimensional design elements, such as point, line, direction, shape, size, colour and texture, levels, light, fenestrations.

**Unit III:** Aesthetic components of design- proportions, scale, balance, rhythm, symmetry, asymmetry, hierarchy, pattern and axis with building examples.

**Unit IV:** Harmony and contrast in 2D and 3D design, interplay of light and shade on building blocks and their effects.

**Unit V:** Form and functions in Architecture, use of building materials, construction techniques and engineering services for different functions.

**Unit VI:** Architectural design process- an analysis- integration of aesthetic and functional utility of spaces.

**Sessional work:** Assignments, tests, and tutorials on the above topics

**Suggested text books:**

1. Ching, F.D.R.: Form, Space and Order, Van Nostrand Rheinhold, New York (1979).
2. Parmar V.S.: Design Fundamentals in Architecture, Somoiya Publications, Bombay (1973)

3. Scott: Design Fundamentals Edward d Mills- Planning the Architects Hand Book – Bitterworth, London, 1985.
4. Watson,D (editor) Time –saver standards for Architectural Design: Technical data for professional practice, McGraw-Hill, 2005.
5. Neufert,P; Architects Data; Blackwell Science, 2000.
6. Agkathidis, A, Hudert, M and Schiling, G, “Form defining strategis: experimental architectural design”. Wasmuth, 2007.

**05FEAR05 FREE ELECTIVE  
(2) LANDSCAPE ARCHITECTURE**

**Objective:** To expose students the role of landscape elements in the planning of parks, gardens, open fields, etc.

**Unit I:** Introduction to Landscape Architecture. Understanding man and nature , land and landscape, relationship of Architecture and Landscape Architecture.

**Unit II :** History of the art of garden design of India, China, Persia, Japan, Italy, France and England.

**Unit III:** Garden design of the modern world.

**Unit IV:** Ecological and environmental aspects of Landscape Design.

**Unit V:** Basic principles of landscape design , elements and its applications.

**Sessional work :**Assignments, tests, and tutorials on the above topics

**References:**

1. Sylvia Crowe Sheila Haywood, The Gardens of Mughal India , Vikas Publishing House, Pvt. Ltd, India, Delhi,1973.
2. Garrett Eckbo, The Art the Home Landscaping, McGraw-hill Book Co., London, 1956.
3. Testsuro Yoshida, Gardens of Japan, Jr. Marcus G. Sims, 1963.
4. Sir Banister Fletcher, A History of Architecture , University of London, The Antholone press, 1986.
5. Percy Brown, Indian Architecture (Islamic period), Taraporevala and Sons, Bombay, 1983tt
6. Satish Grover, The Architecture of India (Buddhist and Hindu Period), Vikas Publishing Housing Pvt. Ltd., New Delhi, 1981
7. Christopher Tadgelli, The History of Architecture in India from the Dawn of Civilization to the end of Raj, Longman group, U.K.Ltd., London, 1990

**05AR06 : ARCHITECTURAL DESIGN STUDIO - V**

**Objective :** To expose the students to the architectural design process of multifunctional building with emphasis on topography, climatic consideration, materials and techniques.

**Basic contents:**

- 1) Introduction to the designing of multifunctional community buildings on an intermediate scale.
- 2) Importance of case studies, data collection, area analysis, evolution of plan forms, climatic oriented planning and design features, space utilization, building & site services, site analysis and site planning ,etc; in the Architectural design process.
- 3) Importance of culture, tradition, topography, climate and building bye laws in generating built form.
- 4) Major design project may be based on commercial, institutional, Hotel, Luxurious apartment, Hospital etc. at appropriate level.
- 5) Architectural study tour relevant to design project.

**Sessional work:** One major design project and one time project with other task and assignments.

Viva Voce by external examiner at the end of Semester.

**Suggested text books:**

1. Ching, F.D.R.: Form, Space and Order, Van Nostrand Rheinhold, New York (1979).
2. Parmar V.S.: Design Fundamentals in Architecture, Somoiya Publications, Bombay (1973)
3. Scott: Design Fundamentals Edward d Mills- Planning the Architects Hand Book – Bitterworth, London, 1985.
4. Watson,D (editor) Time –saver standards for Architectural Design: Technical data for professional practice, McGraw-Hill, 2005.
5. Neufert,P; Architects Data; Blackwell Science, 2000.
6. Agkathidis, A, Hudert, M and Schiling, G, “Form defining strategis: experimental architectural design”. Wasmuth, 2007.

**05AR07 BUILDING MATERIALS & CONSTRUCTION STUDIO -V**

**Sessional work:**

Assignments and drawing on the above topics given in the subject 05AR02 Building Materials & construction – V.

Viva Voce by external examiner at the end of Semester.

**05AR08 INTERIOR DESIGN - I**

**Objective :** To Impart the knowledge of interior design as an integral part of Architectural Design process and the study of latest interior materials.

**Unit - I: History of interior design**

Introduction to history of furniture and importance of styles related to furniture. Vernacular design in India with reference to interior design and decoration.

**Unit – II: Introduction to Interior Design**

Definition of interior design, Interior design process, introduction to the design spaces as related to function, themes, concept, study and design.

**Unit - III: Interiors in residence**

Space organization in interiors , surface treatment in interiors viz. on walls , floors, ceilings etc. Different type of materials that are available and their uses in interiors. Interior Design Project of any small residence.

**Sessional work:**

One major interior design project and one time project with other task and assignments

Viva Voce by external examiner at the end of Semester.

**Suggested Books:**

1. Chiara, J.D., Panero, J., Zelnik, M., “Time Saver Standards for Housing and Residential Development”, 2nd Ed., McGraw-Hill.
2. Neufert, P., “Architects Data”, 3rd Ed., Blackwell Science.
3. Watson, D.(Editor), “Time-saver Standards for Architectural Design: Technical Data for Professional Practice”, McGraw-Hill
4. Ballard Bell, Victoria and Rand, P., “Materials for Architectural Design”, Laurence King

**05AR09 WORKING DRAWING - II**

**Objective :** The students shall impart the knowledge of construction details for the execution of building from foundation to roof level.

**Contains :** Working drawing of RCC structure for design project done during fourth semester. The drawing should be in an appropriate scales.

The working drawing should include from foundation level to roof level as follows :

- a) Study of building byelaws
- b) Municipal drawing and detail of all level plans.

- c) Details center line plan of columns
- d) Working details of any interesting features in the plan, sections & elevation.
- e) Site plan showing drainage layout, landscape layout, internal roads etc.
- f) Working details of water supply & electrical layout plan's.

**Sessional Work :** Assignments and drawing plates on the above topics.

Viva Voce by external examiner at the end of Semester.

**Suggested text books:**

1. Ching, F.D.R.: Form, Space and Order, Van Nostrand Rheinhold, New York (1979).
2. Parmar V.S.: Design Fundamentals in Architecture, Somoiya Publications, Bombay (1973)
3. Scott: Design Fundamentals Edward d Mills- Planning the Architects Hand Book – Bitterworth, London, 1985.
4. Watson,D (editor) Time –saver standards for Architectural Design: Technical data for professional practice, McGraw-Hill, 2005.
5. Neufert,P; Architects Data; Blackwell Science, 2000.
6. Agkathidis, A, Hudert, M and Schiling, G., “Form defining strategies: experimental architectural design”. Wasmuth, 2007.

**SEMESTER : SIXTH****06AR01 ARCHITECTURAL DESIGN - VI**

**Objective :** To expose the students to the architectural design process of multifunctional building with emphasis on topography, climatic consideration, materials and techniques.

**Basic contents:**

- 1) Introduction to the designing of multifunctional community buildings on an intermediate scale.
- 2) Importance of case studies, data collection, area analysis, evolution of plan forms, climatic oriented planning and design features, space utilization, building & site services, site analysis and site planning ,etc; in the Architectural design process.
- 3) Importance of culture, tradition, topography, climate and building bye laws in generating built form.
- 4) Major design project may be based on commercial, institutional Hotel, Luxurious apartment, Hospital etc. at appropriate level.
- 5) Architectural study tour relevant to design project.

**Sessional work:** One major design project and one time project with other task and assignments.

**Suggested Text Books:**

1. Ching, F.D.R.: Form, Space and Order, Van Nostrand Reinhold, New York (1979).
2. Parmar V.S.: Design Fundamentals in Architecture, Somoiya Publications, Bombay (1973)
3. Scott: Design Fundamentals Edward d Mills- Planning the Architects Hand Book – Bitterworth, London, 1985.
4. Watson, D (editor) Time –saver standards for Architectural Design: Technical data for professional practice, McGraw-Hill, 2005.
5. Neufert, P; Architects Data; Blackwell Science, 2000.
6. Agkathidis, A, Hudert, M and Schiling, G., “Form defining strategies: experimental architectural design”. Wasmuth, 2007.

**06AR02 BUILDING MATERIALS & CONSTRUCTION-VI**

**Objective :** The course will enable the learning in progression , starting from simple building elements, components, materials and construction techniques to develop strong sense of visualization.

**Unit I:** Structural steel frame work & trusses for various spans , design consideration, advantages, connection of various members supported on R.C.C. column, brick piers , fixing, wind bracing etc.

**Unit II:** Steel north light roof trusses, connections Gutters, patented glazing etc.

**Unit III:** Patent glazing for skylights, lanterns, steel Monitor roofs, methods of fixing, fixtures and fastenings.

**Unit IV :** Introduction to precast building elements, comparative study with cast in situ constructions. Appropriate use of various types of precast building elements and its construction details.

**Unit V :** Study of Deep foundation. Details study of Pile foundation , types and its purpose.

**Unit VI:** Shoring, purposes and types . Underpinning its purposes and types.

**Sessional work:**

Assignments, test, site visit and drawing on the above topics.

**References :**

1. S.C. Rangwala, Engineering Materials, Charotar Publishing House, Anand, 1997
2. HUDCO - All you want to know about soil stabilized mud blocks, HUDCO Pub, New, Delhi, 1989.

3. W.B. McKay Building Construction, vol. 1,2,3, Longmans, U.K. 1981.
4. Don A Watson, Construction Materials and Processes, McGraw Hill Co., 1972.
5. R. Chudley, Construction technology, Richard Clay (Chaucer Press) Ltd., Suffolk, 1978.
6. J.H. Callender, Time saver standard for Architectural Design Data, McGraw-Hill, 1994.

**06AR03 ARCHITECTURAL STRUCTURE-V**

**Objective:** Understanding of Basic Theory and principles of structural analysis and structural properties of elements.

**Unit I :** Introduction to pre cast concrete.

**Unit II :** Application of thumb rules for beams, columns, slab for fixing & sectional properties.

**Unit III:** Water tanks resting on ground with flexible and rigid base by I. S. code method.

**Unit IV :** Understanding types of joints in steel structures, riveted, welded and bolted joints. Types of steel section and their properties.

**Unit V:** Simple welded and riveted connection (without moments) only axial loads.

**Unit VI:** Design of simple tension and compression member of trusses.

**Sessional work:**

Assignments , tutorials and site visit on the above topics.

**References:**

1. P.C. Punmia, Strength of Materials and Theory of Structures; vol I, Laxmi Publications, Delhi 1994.
2. S. Ramanmurtham, Strength of Materials – Dhanpatrai & Sons, Delhi 1990
3. W.A. Nash, Strength of Materials – Schaums Series – McGraw Hill Book Company, 1989
4. R.K. Bansal – engineering Mechanics and Strength of Materials – Lakshmi Publications, Delhi, 1990

**06AR04 ESTIMATE AND COSTING**

**Objective:** To impart knowledge of cost estimation of building construction work as per specification of materials and its importance.

**Unit I:** Types of estimates. Data required for framing estimate method of preparing estimates , method of preparation of estimate.

**Unit II :** Standard mode of measurement, schedule of rates and its use , Administrative approval, Technical sanction. Competent authority, issue rate , interest, indent of wish etc. .

**Unit III:** Method and procedure of working out abstract and bill of quantities.

**Unit IV:** Examples and exercise for working out quantities for items from excavation to the final finishing of load bearing and R.C.C. items viz. slab, beams , columns etc.

**Unit V:** Rate analysis, factors affecting the rate of an item , rate analysis of advance equipments use in buildings. Cost of materials and labour for various works, detailed rate analysis of important items of construction work. Measurement of work for interim and final certificate of payment.

**Unit VI:** Detail estimate of project given and use of computers for the same.

**Sessional work:** Assignments, tests, and tutorials on the above topics

**References:**

1. W.H.King and D.M.R.Esson, Specification and quantities for Civil Engineers, The English university Press Ltd.
2. P.W.D. Standard specifications, Govt. Publications.
3. Dutta, Estimating and Costing, S. Dutta and Co., Lucknow.
4. Singh, S.C. and Sofat, C.G., Ed., “Handbook on Building Economics and Productivity”, Central Building Research Institute
5. Birdie, G.S., “Text Book of Estimating and Costing (Civil Engineering)”, Dhanpat Rai Publishing Company (P) Ltd.

**06FEAR05 FREE ELECTIVE .**

**(1) CLIMATE RESPONSIVE ARCHITECTURE.**

**Objective:** The course aims to understand the various features to be considered for planning and designing of climate responsive built and un-built spaces.

**UNIT-I :** Introduction of Sun – Earth relationship and its impact on earth surfaces. Thermal balance of Earth, Tropical Zones on earth surfaces.

**UNIT-II :** Human comfort through body metabolisms, heat gain and heat loss , thermal balance of body, clothing pattern its effect on body.

**UNIT-III:** Climatic factors and climatic elements. Importance of climatic factors to create micro and macro climatic conditions.

**UNIT-IV:** Introduction of planning, designing, materials and techniques considered in traditional structures with respect to climate.

**UNIT-V:** Solar charts, types of shading devices, shadow angles and its use.

**UNIT-VI:** Planning and design of building in hot and dry climates.

**Sessional work ;** Assignments and test on the above topics.

**References:**

1. O.H.keonigsberger; T.G. Ingersoll and others; Manual of tropical housing and building- Part-I; Longmans,London-1980
2. M. Evans; Housing, climate and comfort; Architectural press London- 1980
3. B.G.Givoni; Man,climate,and architecture; Applied science, banking, Essex, 1982
4. N.K Bansal and others; Passive building design; Elsevier science- 1994.
5. S.Drake; The third skin architecture,technology and environment;UNSW –press-2007.

**06FEAR05 FREE ELECTIVE**

**(2) SUSTAINABLE ARCHITECTURE.**

**Objective:** To sensitize students about the importance and need for Sustainable Planning concept with respect to conservation of Environment.

**UNIT-I:** Introduction to the ideas, issues and concepts of Sustainable Architecture, global environment and the built environment, principles of environmentally and ecologically supportive architecture.

**UNIT-II:** Study of sustainable architecture in context with resource efficiency viz. Land , Water, Energy, Materials, Human resources,. Biodiversity , health and global environment related to constructions and operation of buildings.

**UNIT-III:** Appropriate materials and constructions to maintain sustainability. Eco friendly construction practices – sustainable campuses and case studies.

**UNIT-IV:** Sustainable and conservation practices, water conservation, sewerage treatment, solid waste treatments, economics and managements.

**UNIT-V:** Low energy design, hybrid system, modeling and simulation of energy system, integration of P.V. and wind system in the building, wind, solar and other non-conventional energy systems.

**UNIT-VI:** Climatic factors and sustainability.

**Sessional work :** Assignments and test on the above topics.

**References:**

1. O.H.keonigsberger; T.G. Ingersoll and others; Manual of tropical housing and building- Part-I; Longmans,London-1980
2. M. Evans; Housing, climate and comfort; Architectural press London- 1980
3. B.G.Givoni; Man,climate,and architecture; Applied science, banking, Essex, 1982
4. N.K Bansal and others; Passive building design; Elsevier science- 1994.
5. S.Drake; The third skin architecture,technology and environment;UNSW–press-2007.

**06FEAR06 (1)ACOUSTICS AND ILLUMINATION**

**Objective:** To enable the students understand the articulation of sound within and around building, fundamentals of sound propagation and lighting requirements in buildings.

**UNIT-I:** Fundamentals - sound waves , frequency, intensity , wave length, measure of sound, decibel scale, speech and music frequencies, human ear characteristics.

**UNIT-II:** Sound transmission and absorption – outdoor noise levels, acceptable indoor noise level, sonometer. Sound absorbing materials, absorption co-efficient and measurements, resonance reverberation time , sound levels and their calculations.

**UNIT-III:** Acoustical defects and remedies. Structure borne and air borne noise, their effects and control.

**UNIT-IV:** Site selection, shape, volume, treatments for interior surfaces, basic principles in designing open air theatres, cinemas , broadcasting studio, concert hall , theaters, lecture Halls.

**UNIT-V:** Principles of Illumination- Visual tasks - factors affecting visual task – Modern theory of light and colour - synthesis of light - luminous flux - candela – solid angle illumination – Utilizations factor- Depreciation factor – MSCP – MHCP Laws of illumination. Application of laws in lighting calculations using point by point method.

**UNIT-VI:** Lighting Design – Classification of lighting – Artificial light sources - spectral energy distribution – luminous efficiency. Design of modern lighting for stores, offices, schools, hospitals and houses lighting.

**Sessional work :** Assignments and test on the above topics.

**References:**

1. Indian Standard ( 732)– Electrical Wiring Installation
2. Indian Standard ( 3646)– Interior Illumination Part I, II, III
3. Indian Standard ( 3043)– Earthing
4. Taylor E. O., “Utilisation of Electric Energy (in SI units)”, Orient Longman, Revised in S.I. units by Rao, V.V.L
5. Dr. V. Narasimhan – An Introduction to Building Physics – Kabeer Printing Works, Chennai – 5 – 1974
6. Thomas D.Northwood–ArchitecturalAcoustics–Dowden, Hutchinson and Ross Inc.- 1977

**06AR07 ARCHITECTURAL DESIGN STUDIO - VI**

**Objective :** To expose the students to the architectural design process of multifunctional building with emphasis on various building services such as lighting , ventilation, movement, fire safety, security , water supply, sewage etc.

**Basic contents:**

- 1) Introduction to the designing of multifunctional community buildings on an intermediate scale.
- 2) Importance of case studies, data collection, area analysis, evolution of plan forms, climatic oriented planning and design features, space utilization, building & site services, site analysis and site planning, etc; in the Architectural design process.
- 3) Importance of culture, tradition, topography, climate and building bye laws in generating built form.
- 4) Major design project may be based on commercial, institutional Hotel, Luxurious apartment, Hospital etc. at appropriate level.
- 5) Architectural study tour relevant to design project.

**Sessional work:** One major design project and one time project with the other task and assignments. on the above topics given in subject Assignment & drawing 06AR 01.

Viva Voce by external examiner at the end of Semester.

**Suggested text books:**

1. Ching, F.D.R.: Form, Space and Order, Van Nostrand Rheinhold, New York (1979).
2. Parmar V.S.: Design Fundamentals in Architecture, Somoiya Publications, Bombay (1973)

3. Scott: Design Fundamentals Edward d Mills- Planning the Architects Hand Book – Bitterworth, London, 1985.
4. Watson, D (editor) Time –saver standards for Architectural Design: Technical data for professional practice, McGraw-Hill, 2005.
5. Neufert, P; Architects Data; Blackwell Science, 2000.
6. Agkathidis, A, Hudert, M and Schiling, G, “Form defining strategies: experimental architectural design”. Wasmuth, 2007.

#### 06AR08- BUILDING MATERIALS & CONSTRUCTION STUDIO -VI

##### Sessional work:

Assignments and drawing on the above topics given in the subject 06AR02 Building Materials & construction – VI.

Viva Voce by external examiner at the end of Semester.

#### 06AR09 INTERIOR DESIGN - II

**Objective :** To Impart the knowledge of interior design as an integral part of Architectural Design process and the study of latest interior materials.

**Unit- I :** Introduction to various elements in interiors like floors, ceilings, walls, staircase, openings, interiors services, incidental elements etc. and various methods of their treatment involving use of materials and methods of construction in order to obtain certain functional , aesthetic and psychological effects.

**Unit - II:** Visual perception of interiors spaces, functions, form, scale proportions , balance, harmony and rhythm. Market survey of recent Interior materials and their application, case studies of outstanding interior design examples. .

Unit - III: Ergonomics in interior Design with respect to human comfort, interior design of furniture for specific types of recreational, educational, office and commercial activities.

**Sessional work:** One major interior design project on the above topics with assignments.

Viva Voce by external examiner at the end of Semester.

##### Suggested Books :

1. Chiara, J.D., Panero, J., Zelnik, M., “Time Saver Standards for Housing and Residential Development”, 2nd Ed., McGraw-Hill.
2. Neufert, P., “Architects Data”, 3rd Ed., Blackwell Science.
3. Watson, D.(Editor), “Time-saver Standards for Architectural Design: Technical Data for Professional Practice”, McGraw-Hill
4. Ballard Bell, Victoria and Rand, P., “Materials for Architectural Design”, Laurence King

**SYLLABUS PRESCRIBED FOR  
FOUR YEAE DEGREE COURSE IN  
INSTRUMENTATION ENGINEERING  
SEMESTER PATTERN (CREDIT GRADE SYSTEM)  
FIFTH & SIXTH SEMESTER**

#### FIFTH SEMESTER

#### 5 IE01 INTRODUCTION TO MICROPROCESSORS & MICROCONTROLLERS

**Unit I:** Introduction to Intel 8085, Architecture and operation, Pin Diagram, Data flow to/from Memory, Bus timings, T States, Machine Cycles, Timing Diagram, Address Decoding Schemes, Memory Mapping's, Comparison of Zilog 80 and Motorola 6800, Introduction to 8086.

**Unit II:** Addressing Modes of 8085, Instruction Set of 8085, Address space partitioning, Programming practice using 8085.

**Unit III:** Programming Practice using Time Delays, Looping, Counting, Indexing. Interrupt Structure of Intel 8085, Serial Data transfers using SID and SOD.

**Unit IV :** Concept of General purpose programmable devices like Intel 8155, 8255, Architecture, Interfacing & programming with Intel 8085. Architecture, Interfacing & programming of Intel 8253/54, 8279.

**Unit V :** Serial Data transfers using Intel 8251 (usart), Architecture, Interfacing & programming with Intel 8085. Concept of Bus Standards like RS 232C & IEEE 488. Concept of DMA , Architecture, Interfacing & programming of Intel 8237 with 8085.

**Unit VI:** Block diagram of microcomputer, block diagram of microcontroller, comparison between microprocessor and microcontroller, microcontroller survey (8-bit, 16-bit, 32-bit), Features, pin out diagram, internal block diagram, CPU registers, flags, PSW, PC, Data Pointer, SFR, SP, Internal RAM/ROM, External memory, I/O ports.

**Practical: Students are expected to perform minimum 8 experiments based on above syllabus.**

##### TEXTBOOK:

- 1) Gibson G.A., Liu Y.C. : Microcomputer system the 8086/8088 family, Prentice Hall India Pvt. Ltd., New Delhi (Second edition), 1996.
- 2) Hall D.V. : Microprocessor and Interfacing Programming and Hardware, McGraw Hill Co., New York, 1986.

- 3) Gaonkar R.S. : Microprocessor Architecture Programming and Applications with the 8085, Penram International Pub. (Third Edition), 1997.
- 4) Data sheet of national semiconductors
- 5) "8051 Microcontroller: Architecture, Programming and applications" by Ayala K.J. 2<sup>nd</sup> Edn., Penram international

**REFERENCE BOOK:**

1. 8088 & 8086 Microprocessor By Walter A. Triebel

**5 IE02 POWER ELECTRONICS**

- Unit I:** SCR, Triac, Diac-construction, characteristics & applications, two transistor analogy for turning ON-OFF SCR, turn ON mechanism, different methods of turning ON-OFF SCR, turn OFF mechanism, Thyristor firing circuits. Introduction to GTO, power transistor, power MOSFET & IGBT & their construction & characteristics.
- Unit II:** Series parallel operation of SCR's, static & dynamic equalizing ckts., equalisation of current in parallel connected SCR's, string efficiency, derating factor, Protection of SCR's against di/dt, dv/dt, radio freq., interference, over voltage, over current.
- Unit III:** Principle of phase control, half wave controlled rectifier, half controlled bridge & fully controlled bridge rectifier for resistive and RL load derivation for output voltage and current, effect of free wheeling diode, single phase dual converters. Three phase half controlled bridge and fully controlled bridge rectifier. (only descriptive approach)
- Unit IV:** Classification of ckt. for forced commutation, series inverter, improved series inverter, parallel inverter, out put voltage and waveform control, principle of operation for three phase bridge inverter in 120 deg. and 180 deg. mode, single phase transistorised bridge inverter.
- Unit V:** Basic principles of chopper, time ratio control and current limit control techniques, voltage commutated chopper ckt., Jones chopper, step-up chopper and AC chopper. Basic principle of cycloconverters, single phase to single phase cycloconverter.
- Unit VI:** Speed control of DC series motors using chopper, speed control of DC shunt motor using phase controlled rectifiers, speed control of three phase induction motor by stator voltage control, v/f control and slip power recovery scheme. Static ckt. braker, UPS, fan speed regulator, principle of soft start ckts. Zero Voltage Switch.

**PRACTICALS:** Students are expected to perform minimum 8 experiments based on above syllabus.

**TEXT BOOKS:**

- 1) P.C.Sen - Power Electronics.
- 2) M.D.Singh & K.B.Khanchandani - Power Electronics, Tata McGraw Hill

**REFERENCES BOOKS :**

- 1) M. Ramamoorthy - Thyristor and their application.
- 2) M.H.Rashid - Power Electronics Ckts., Devices and Application.
- 3) Dr.P.S. Dhimbra - Power Electronics.

**5 IE03 CONTROL SYSTEMS**

- Unit I:** Definition of control system, closed and open loop systems; transfer function, derivation of transfer functions of physical systems, block diagrams reduction, signal flow graphs.
- Unit II:** Time response analysis: Analysis of first, second order systems, static and dynamic errors coefficients, errors criteria, stability of control system using Routh Hurwitz's stability criterion.
- Unit III:** Introduction of Root Locus method; Root Locus plots, Rules for constructing root loci, stability analysis of systems using Root locus, Root contour plots, effect of zeros & poles.
- Unit IV:** Introduction of frequency response, Bode plots, stability analysis of systems using Bode plots, polar plots, Nyquist stability criterion, relative stability.
- Unit V:** State space representation of systems, conversion of state variable models to transfer functions, conversion of transfer functions to state variable models, solution of state equations, concepts of controllability and observability.
- Unit VI:** Sample data control systems :representation of sampled data (Discrete) systems, review of Z-transforms, sampler and hold ckt., Z-transform analysis of sampled data of sampled data control systems (open & closed loop systems), Z transform of systems. Solution of difference equation by Z transform methods. Response of discrete systems. Digital controller & its transfer functions. Stability analysis of discrete time system using bilinear transformation.

**TEXT BOOKS:**

- 1) K. Ogata: Modern Control Engg. (PHI)
- 2) Anand Kumar: Fundamental of Control Systems (PHI)



**REFERENCE BOOKS :**

- 1) M. Gopal : Digital Control Systems Principles & Design (TMH)
- 2) I.J. Nagrath & M.Gopal : Control System Engg. (Wiley Eastern)

**5IE04 ELECTRONIC INSTRUMENTATION**

**Unit I:** Study of logic family RTL, DCTL, DTL, TTL, MOS logic, CMOS logic, characteristics of digital ICS

**Unit II:** Study of Flip-flops, Shift Register, Counter.

**Unit III:** Semiconductor memories, sequential memories, CMOS register stages, BJT RAM cell, MOS RAM, A to D and D to A conversion techniques.

**Unit I:** Different types of signal generators, Design and use of regulated power supplies, Precision ohmmeter, RF power and Voltage measurement, automated voltmeter, RLC Meter, tan  $\delta$  Meter.

**Unit V:** Digital time measurement technique: venire technique for small time interval measurement, measurement of periodic time, measurement of phase, capacitance, And quality factors.

**Unit VI:** Digital frequency measurement technique: measurement of ratio, product and differences between two frequency, High freq. measurement, Peak freq. measurement, Fast low freq. measurement.

**TEXT BOOKS:**

1. Modern digital Electronic By R.P. Jain (TMH)
2. Digital Measurement Technique by Rathore T.S.
3. Modern electronic Instrumentation and measurement techniques by W.D. Cooper & A.D. Helfric

**REFERENCE BOOK:**

1. Digital design By Morris Mano

**5FEIE05 FREE ELECTIVE –I****1) SENSORS & TRASDUCERS**

**Unit I:** **Viscosity Measurement:** Terminology, Units, Types - Capillary, Efflux cup, Saybolt, Searle's rotating cylinder, Float type, Gyration element, Vibrating Reed, Plastometers, Cone and plate, Falling and rolling ball, Covettee concentric cylinder, Rota meter

**Unit II :** **Density Measurement:**

**Liquid :** Chain-balanced float type, Electromagnetic suspension, Angular position, Hydrometer (Buoyancy type), Gravitolmeter

( U tube type ), Hydrostatic Head ( Air bubbler, DP Cell ), Oscillating Coriolis, Radiation

**Gas:** Gow-Mac, Displacement type, Centrifugal gas, Gal column balance, Electromagnetic suspension, Displacement type, thermal conductivity bridge type.

**Unit-III: Chemical Measurements**

**Consistency Measurement:** Probe type, blade type, float type, Rotating type, Optical, Level consistency meter, Flow Bridge, CT and PT method.

**Turbidity Measurement:** Double Beam method, Laser type, Light Scattering, Back scattering analyser, Nephelometer, Suspended solids and sludge density sensor.

**Unit-IV: Analytical Measurements**

**Composition Measurement**

**Colour Measurement :** Photo reflective, Photoelectric, through beam type

**Radiation Measurement:** Chromatography,, flow through porous electrodes and detectors, on-line measurements

**Moisture in Solids:** Nuclear moisture gauge, Infra Red Absorption or Reflection, Microwave solid moisture analyser, NMR, Conductance and capacitance probes.

**Unit V: Environnemental Measurements**

**Microphones :** **Capacitive,** Piezo electric, Electrodynamics, Carbon granule, Ribbon type SPL meter

**Smoke Detector :** Smoke detector

**Dust :** Air Pollution standard, Air pollution sampling and Measurement

**CO & CO2 :** Measuring Techniques for CO, CO2, NOX and SOX

**Fire, Flame, Leak Detection**

**Non Destructive Testing:** Metal Detector, Non Metal Detector

**Unit VI: Moisture Measurement**

**Moisture in Gases and Liquids:** Electrolytic hygrometer, capacitance, Piezoelectric, Impedance, Head of Adsorption, Infra Red, Resistivity / Conductivity types.

**Moisture in Solids:** Nuclear moisture gauge, Infra Red Absorption or Reflection, Microwave solid moisture analyser, NMR, Conductance and capacitance probes.

**TEXT BOOKS:**

1. Rangan, Sharma, "Instrumentation Devices and Systems", Mani-Tata McGraw-Hill- Second Edition.

2. Nakra Chaudhary," Instrumentation Measurement and Analysis", Tata McGrawhill-21<sup>st</sup> Reprint.
3. D. Patranabis,"Principles of Industrial Instrumentation", Tata McGrawhill-7<sup>th</sup> Reprint,1986
4. A. K. Sawhney,Electrical and Electronic Measurements and Instrumentation",Dhanpat Rai and Sons , Delhi-2002print
5. R.K.Jain,"Mechanical and Industrial Measurement",Khanna Publications-9th print

#### REFERENCE BOOKS:

1. Andrew Williams, "Applied Instrumentation in Process Industries(Vol.I)",Gulf Publications Company- Second Edition
2. B. G. Liptak- Butterworth Heinemann, "Process Measurement and Analysis" Third Edition
3. B. E. Noltingk EL/ BS ,"Jone's Instrument Technology ( Vol. 1 and Vol. 2)", Fourth Edition
4. E. O. Doebelin, "Measurement System Application and Design", McGraw-Hill International- Fourth Edition

#### FREE ELECTIVE - I

##### 5FEIE05 (2) ADVANCE SENSORS AND TRANSMITTERS

- Unit I :** Flow Transducers: Basic measurement principles, Differential pressure Type (Orifice, Ventury, Anubar Pitot tube),Variable area type, Positive displacement type ,Mass flow meter.
- Unit II:** Intelligent sensor: Introduction, Features , desirable on chip signal processing, present status.  
MEMS Sensor: Introduction, MEMS sensor-Design challenges, MEMS sensor-generation & development.
- Unit III:** PH & Conductivity sensors: PH scale and standard principal of pH measurement ,different types of reference & measuring electrode .Principal of conductivity measurement, conductivity cells & bridges.
- Unit IV:** Density measurement: Introduction, various scale, hydrometer type, vibrating densitometer, gas Densitometer, ultrasonic sludge densitometer, centrifugal gas density sensor. Viscosity measurement: Definition, capillary type, cone plate.
- Unit V :** Biosensor Technology: Introduction, Nanosensor: Nanotechnology Introduction, nanosensor development, future of nanosensor.  
Positioners : necessity, types and effect on performance of control valve, Actuators: pneumatic, hydraulic, electrical, electro-pneumatic, electro-hydraulic.

**Unit VI:** Transmitters: Buyancy ,differential pressure, temperature, electro hydraulics,2 wire transmitters, Converters: Resistance to current ,voltage to current, pneumatic to electrical & electrical to Pneumatic.

#### TEXT BOOKS :

1. Sensors and transducer by Dr. A.D. Shaligram First Edition
2. Sensors and Transducer by D. Pathanbis

#### REF. BOOKS :

1. Electronics Instrumentation and measurement by A.K. Sawhney
2. Process control By B.G. Liptak

#### 5IE06 COMMUNICATION SKILLS

- Unit I :** Comprehension over an unseen passage.  
Comprehension - A - word study :- Synonym, antonym, meanings, matching words, adjectives, adverbs, prefix and suffix, correct forms of commonly misspelled words, understanding of the given passage, reading  
Comprehension - B - Structure study :- Simple and compound sentences, types of conjunctions, singular and plural, tenses and their effect on verb forms. Use of - not only - but also, if clause, since, may, can, could, would, too etc.  
Active and passive forms, negative and interrogative, punctuation and capitalization. Summary, Precise & abstract writing. **(10 Hours)**
- Unit II:** Theoretical background - importance of communication, its process, model of communication its components & barriers. Verbal communication, its significance, types of written communication, organization of a text (Titles, summaries, headings, sequencing, signaling, cueing etc.), Important text factors (length of paragraph, sentences, words, clarification and text difficulty). Evaluation of written communication for its effectivity and subject content.  
Non-verbal communication, types of graphics and pictorial devices. **(10 Hours)**
- Unit III:** Specific formats for written communication like – business correspondence, formal reports, technical proposals, research papers and articles, advertising and graphics. Format for day-to-day written communication like writing applications, Resume, notices, minutes, quotations, orders, enquiries etc. Claim letter.  
Oral communications - Important objectives of interpersonal skills, soft skills(listening, speaking strategy), (verbal and non-

verbal), face to face communications, group discussion and personal interviews.

Methodology of conduction of meetings, seminars, symposia, conference and workshop. **(10 Hours)**

#### **BOOKS RECOMMENDED :**

- 1) Krishna Mohan, Meera Banerjee : Developing Communication Skills, MacMillan India Limited.
- 2) M.A. Rizvi: Effective Technical communication, Tata McGraw Hill.
- 3) Urmila Rai & S.M.Rai : Communication Skills ,Himalaya Publisher House.
- 4) Chrissie Wright (Editor) : Handbook of Practical Communication Skills, Jaico Publishing House.
- 5) Dr. Nageshwar Rao & Dr. Rajendra P. Das : Communication skills, Himalaya Publisher House.

#### **5IE09 Communication Skills Lab:**

**Objective:** On completion of this laboratory the candidate should be able to demonstrate adequate skills in oral and written communication for technical English language actively participate in group discussions and interviews and exhibit the evidence of vocabulary building. Candidates should be assessed through continuous monitoring and evaluation. The sample list of experiments is given below. This list can be used as guideline for problem statements but the scope of the laboratory should not be limited to the same. Aim of the list is to inform about minimum expected outcomes.

1. Assignments and tests for vocabulary building
2. Technical report writing
3. Group discussions
4. Interview techniques
5. Projects and tasks such as class news letter
6. Writing daily diaries and letters
7. Interactive language laboratory experiments.

**TEXT BOOK:** Norman Lewis: Word Power Made Easy

### **SIXTH SEMESTER**

#### **6 IE01 CONTROL SYSTEM COMPONENTS**

**Unit I :** Introduction to control system components - electrical, mechanical, hydraulic, pneumatic. Comparison of these systems ,Control actions : two point control (on/off) , proportional (P), integral (I), derivative (D), PI, PD, PID, offset in P action, reset windup, effect of PID on process characteristics, tuning of PID Controller.

**Unit II :** Control valve: terminology, types, characteristics, selection criteria, concept of Cv, Calculation of Cv and trim size. Control Valve design for (Gas, Vapor, and Liquid). Effect and remedies of cavitations, Flashing condition, Valve noise , Calculations , reduction methods.

#### **Unit I : Hydraulic Components**

**Hydraulics:** Principle, Block Diagram, Advantages, Disadvantages, Applications, Hydraulic Fluid.

**Hydraulic components:** Hydraulic Power Pack, Hydraulic Filters, Hydraulic Pumps, Actuator (cylinders & motors), Hydraulic valves.

**Hydraulic Circuits:** Development of hydraulic circuits using Standard Symbols. Hydraulic Circuits like Meter in, Meter out, Reciprocating, speed control, Sequencing of cylinders, Direction control, Deceleration, Regenerative circuit.

#### **Unit IV : Pneumatic Component:**

**Pneumatics:** Principle, Block Diagram, Advantages, Disadvantages, Applications.

**Pneumatic components:** Pneumatic Power Supply, Types of Pneumatic Relay, FRL unit, Pneumatic Actuator (cylinders and Air motors), Pneumatic valves.

**Pneumatic Circuits:** Development of Pneumatic circuits using Standard Symbols. Sequence diagram (step-displacement) for implementing pneumatic circuits. Different Pneumatic Circuits like Reciprocating, Sequencing, Anti-cycle repetition, Block transfer, Speed regulation, Job sorting, Electro-pneumatic circuits.

**Unit V : Switches:** Construction, symbolic representation, working, application of Toggle switch, Slide switch, DIP switch, Rotary switch, Thumbwheel switch, Selector switch, Push button, Drum switch, Limit switch, Emergency switch, Micro-switches, Review of process switches, Switch specifications.

**Unit VI: Relays:** Construction, working, specifications, selection criteria and applications of Electro-mechanical relay, Reed relay, Solid-state relays.

**Contactors:** Construction, working, specifications and applications of contactors. Comparison between relay and contactor. Development of wiring diagram (using switches, Relays, Contactors). Annunciator system.

**Practicals: Students are expected to perform minimum 8 experiments based on above syllabus.**

**TEXT BOOKS:**

- 1) C.D.Johnson : Process Control and Instrument Technology
- 2) A.Anderson : Instrumentation for Process Measurement and Control
- 3) Process Control Principal and application by Surekha Bhanot , Oxford University Press
- 4) Industrial Hydraulics by Pipepinger
- 5) Control system component by M.B. Desai (PHI)

**REFERENCEBOOKS:**

1. Hand book Process control By B.G.Liptak Vol. II
2. P.Harriott : Process Control

**6IE02 UNIT OPERATIONS**

**Unit I :** Basic concept: Unit operation and unit process concept: Block diagram of Chemical process, Classification of unit operation, Material and Energy balance, Batch and Continuous Process, Endothermic and Exothermic reaction, Reversible and Irreversible Process, Humidification and Dehumidification. Extraction: Field of Application of liquid Extraction, Selection of solvent, Extraction Equipments (Mixer- settlers , spray column) Leaching Equipment.

**Unit II :** Transportation & Systems: Classification, Efficiency, and Characteristics of Pumps, Compressors, Fans, Blowers and NPSH of Centrifugal Pumps. Heat Exchangers: Types of Heat Exchangers.

**Unit III :** Distillation: Continuous Fractionating Columns, Plate efficiencies. Influencing plate efficiency, Flash Distillation and Batch distillation. Drying: Principle of drying, Classification of dryers, Temperature patterns in dryers , Drying equipment, Selection of drying equipment.

**Unit IV :** Chemical reactors: Classification of chemical reactors, flow dia., effect of **Variables** such as temperature, Pressure, Reactor concentration, flow pattern & reaction kinetics.

**Evaporation:** Types of Evaporators, Single effect evaporators, multiple effect evaporators, forced Circulation evaporator.

**Unit V :** Introduction to Process Industries: Nitrogen Industries: Synthesis of Ammonia, Nitric Acid, And Urea. Manufacturing Process of Cement Plant and Paper and Pulp Industries.

**Unit VI : Filtration:** Mechanism of filtration, Rotary drum filter, flow sheet for Continuous vacuum Filtration, suspended batch. Centrifuges, Clarifying filter, cyclone types of industrial filters, Bag filters.

**Crystallization:** Types

**Separation:** -Hydro clones, centrifugal decanters, Disk centrifuge.

**Size reduction:** Crushing law, crushing equipment, types of grinders.

**TEXT BOOKS:**

- 1) Unit Operation of Chemical Engg. By Maccabe Smith Harriott, McGraw-Hill.
- 2) Chemical Engineer's Handbook by Perry, 6/c McGraw Hill ,1984
- 3) Outline of Chemical Technology by M. Gopala Rao, Marshall Sittig (3/e)

**REFERENCEBOOKS:**

- 1) Outline of Chemical Technology by M.G.Rao & Misting, 2/e, East west, 1973
- 2) Designing of Thermal System by Stoker, 3/e.

**6 IE03 DIGITAL CIRCUITS DESIGN**

**Unit I :** Combinational Logic Design: Function of binary variables, Boolean Algebraic theorems, standard form of logical functions, K-map up to five variables, Quine McClusky method, Don't care conditions and it's effects, Synthesis using AND - OR gates.

**Unit II :** Combinational logic design using 74/54 series MSI chip series concerning to multiplexers, demultiplexers, decoders, encoders, comparators, code converters, priority encoders parity generator/ checker & BCD-Seven segment decoder.

**Unit III :** Combinational logic design using ROM array, PLA, PAL preliminary design concepts using FPGA's N-bit binary adder using 7480, Look-ahead carry adder construction.

**Unit IV :** Design of counter and sequential networks: Analysis of clocked sequential networks, General models of sequential machines, Equivalence and minimization networks, Deviation of state graph and tables, reduction of state assignments, S.M.Chart.

**Unit V :** Analysis of asynchronous sequential networks, derivation and reduction of primitive flow tables, state assignments and

realization of flow tables, hazards, asynchronous sequential network design.

**Unit VI :** Fault detection and location in combinational circuits: Path sensitizing method, Equivalent - Normal-Form (ENF) method, Two-level fault detection. Fault detection and location in sequential circuits using circuit test approach.

**TEXT BOOKS :**

1. Charles H. Roth : “Fundamental of Logic Design” , 4th ed. Jaico Publication.
2. Lee S.C. : “Digital Circuit and Logic Design”, Prentice Hall of India Pvt. Ltd., New Delhi
3. Jain R.P. : “Modern Digital Electronics Circuits and Systems”, Macmillan Press, London

**REFERENCE BOOKS:**

1. Fleatcher : An Engineering approach to Digital System Design “, PHI
2. Morris N.M. : “Digital Electronics Circuits & Systems”, Mac millan Press, London
3. Digital IC reference data manual
4. Texas Instru. Incorporated : Designing with TTL IC’s.
5. Parag K. Lala : Fault Tolerant and Fault Testable Hardware Design, B.S. Publication, Hydrabad.

**6 IE04 ANALOG AND DIGITAL INTEGRATED CIRCUITS**

**Unit I:** Differential amplifier: gain expressions using H parameters, transfer-characteristics, constant current source, block diagram of op-amp, frequency response, frequency compensation methods, study of ICs uA741, measurement of parameters of op-amp and off set nulling and their importance.

**Unit II:** Linear Applications of Op-Amp Inverting and non inverting amplifiers, voltage followers , integrator, differentiator, differential amplifier, bridge amplifier, instrumentation amplifiers, precision rectifiers, RMS to DC converter, voltage to current converter, sinusoidal RC oscillators, constant voltage sources, frequency to voltage and voltage to frequency convertor.

**Unit III:** Non Linear Applications of Op-Amp and Filter Circuits Clipping and clamping circuits, comparator, astable, monostable and bistable multivibrator, Schmitt trigger, voltage sweep generator, active filters : Butterworth, Chebyshev filters using op-amp, log and antilog amplifiers , Sample & hold circuit.

**Unit IV :** Voltage Regulator :Block schematic of regulator IC 723, regulated power supply using IC 723, short circuit protection, switch mode

power supply, dual tracking regulators, regulator using 78\*\*, 79\*\*, and LM 317.

**Unit V:** Timers: Block schematic of IC 555, application of timer 555 as astable, monostable and bistable multivibrators, delayed timer, sawtooth generator, FSK modulator.

**Unit VI:** PHASE LOCKED LOOPS: Operation of phase lock loop system, transfer characteristics, lock range and capture range, study of PLL IC-LM 565 and its applications as AM detector, FM detector and frequency translator.

**Practicals: Students are expected to perform minimum 8 experiments based on above syllabus.**

**TEXT BOOKS :-**

- 1) Gayakwad R.A. : OP-Amps and Linear Integrated Circuits, Prentice Hall of India Pvt. Ltd., New Delhi (Second Edition), 1980.
- 2) Milliman J. and Grabel A. : Microelectronics, McGraw Hill Book Co. New Delhi, 1985.
- 3) Herb Taub and Donald Schilling : Digital Integrated Circuits, McGraw Hill Pub.
- 4) Operational Amplifier and Linear ICs By David A. Bell , PHI

**REFERENCE BOOKS:**

- 1) Tobey J.E. and Grame J.E. : Operational Amplifier Design and Applications, International Student Edition, 1983.
- 2) Linear Application Handbook : National Semiconductors.
- 2) Application Node on IC : BEL India.

**6IE05 FREE ELECTIVE – II**

**(i) CONTROL SYSTEM COMPONENTS**

**Unit I:** Control valve: terminology, types, characteristics, selection criteria, concept of Cv, Calculation of Cv and trim size, Control valve Characteristics, cavitations and flashing, Valve noise.

**Unit II:** Hydraulic Components

**Hydraulics:** Principle, Block Diagram, Advantages, Disadvantages, Applications, Hydraulic Fluid. Hydraulic components: Hydraulic Power Pack, Hydraulic Filters, Hydraulic Pumps, Actuator (cylinders & motors), Hydraulic valves.

**Unit III:** Pneumatic Component:

**Pneumatics:** Principle, Block Diagram, Advantages, Disadvantages, Applications.

**Pneumatic components:** Pneumatic Power Supply, Types of Pneumatic Relay, FRL unit, Pneumatic Actuator (cylinders and Air motors), Pneumatic valves, Flapper nozzle system, Pneumatic Circuits: Development of Pneumatic circuits using Standard Symbols.

**Unit IV :** Switches: Construction, symbolic representation, working, application of Toggle switch, Slide switch, DIP switch, Rotary switch, Thumbwheel switch, Selector switch, Push button, Drum switch, Limit switch, Emergency switch, Micro-switches, Review of process switches, Switch specifications.

**Unit V:** Relays: Construction, working, specifications, selection criteria and applications of Electro-mechanical relay, Reed relay, Solid-state relays.

**Contactors:** Construction, working, specifications and applications of contactors. Comparison between relay and contactor. Development of wiring diagram (using switches, Relays, Contactors). Annunciator system.

**Unit VI: Pumps and Compressors**

Basics classification, Efficiency, and Characteristics of pumps and compressors, principle and working of compressor and pump, Surge and Antis surge of compressor Basics and multivariable instrumentation and control scheme including safety and performance consideration of pump and compressor.

**Text Books:**

- 1) C.D.Johson : Process Control and Instrument Technology
- 2) A.Anderson : Instrumentation for Process Measurement and Control
- 3) P.Harriott : Process Control
- 4) Industrial Hydraulics by Pipepinger
- 5) Control system component by M.B. Desai (PHI)

**FREE ELECTIVE - II**

**(ii) INDUSTRIAL AUTOMATION & PROCESS CONTROL**

**Unit I: Automation:** Fundamentals of Industrial Automation, Need and role of Automation, Evolution of Automation, Elements of process control loop, Current Trends, Automation Strategy evolution, Control system audit, Automation Tools and strategies and their location in plant.

**Unit II:** Introduction to Process control , Types of processes, process characteristics and controllability, time constant of a process , dead time in process, classification of process variables ,difficulties and requirement of process control implementation , self regulating and non-self regulating Processes, interacting & non-interacting processes.

**Unit III:** Introduction to control system components - electrical, mechanical, hydraulic, pneumatic. Comparison of these systems ,Control actions : two point control (on/off) , proportional (P), integral (I), derivative (D), PI, PD, PID, offset in P action.

**Unit IV :** Introduction to PLC , Types of PLC , Block diagram, processor section , Specification of advance PLC, Input modules & output module (Analog , Digital , Discrete ). Communication modules, limit switches, scan time, Development of simple ladder diagrams.

**Unit V:** DCS Introduction, Location of DCS in Plant, functions, advantages and limitations, DCS as an automation tool to support Enterprise Resources Planning, Comparison of DCS with PLC,.DCS components/ block diagram, Architecture, Functional requirements at each level, DCS specifications, Latest trends and developments , Performance Criteria for DCS.

**Unit VI:** Introduction to supervisory control: Introduction, Block diagram, SCADA system integrated with PLC, Channel, Scanning, Interrupt Scanning, Data processing, Distributed SCADA system, RTU, Industrial application of SCADA.

**Text-Books :**

1. C. D. Johnson, "Process control and Instrument technology", TMH.
2. N.A. Anderson, "Instrumentation for Process measurement and control",
3. Considine, "Process measurement and control",

**Reference Books :**

1. B.G Liptak, "Process Control, Instrument Engineering Hand book",
2. Tuning of industrial control systems, ISA
3. Control valve Handbook, ISA

**6IE06 COMMUNICATION SKILLS**

**Unit I :** Comprehension over an unseen passage.  
Comprehension - A - word study :- Synonym, antonym, meanings, matching words, adjectives, adverbs, prefix and suffix, correct forms of commonly misspelled words, understanding of the given passage, reading  
Comprehension - B - Structure study :- Simple and compound sentences, types of conjunctions, singular and plural, tenses and their effect on verb forms. Use of - not only - but also, if clause, since, may, can, could, would, too etc.  
Active and passive forms, negative and interrogative, punctuation and capitalization. Summary, Precise & abstract writing. **(10 Hours)**

**Unit II:** Theoretical background - importance of communication, its process, model of communication its components & barriers. Verbal communication, its significance, types of written communication, organization of a text (Titles, summaries, headings, sequencing, signaling, cueing etc.), Important text factors (length of paragraph, sentences, words, clarification and text difficulty). Evaluation of written communication for

its effectivity and subject content. Non-verbal communication, types of graphics and pictorial devices. **(10 Hours)**

**Unit III:** Specific formats for written communication like – business correspondence, formal reports, technical proposals, research papers and articles, advertising and graphics. Format for day-to-day written communication like writing applications, Resume, notices, minutes, quotations, orders, enquiries etc. Claim letter.

Oral communications - Important objectives of interpersonal skills, soft skills(listening, speaking strategy), (verbal and non-verbal), face to face communications, group discussion and personal interviews.

Methodology of conduction of meetings, seminars, symposia, conference and workshop. **(10 Hours)**

#### **BOOKS RECOMMENDED :**

- 1) Krishna Mohan, Meera Banerjee : Developing Communication Skills, MacMillan India Limited.
- 2) M.A. Rizvi: Effective Technical communication, Tata McGraw Hill.
- 3) Urmila Rai & S.M.Rai : Communication Skills ,Himalaya Publisher House.
- 4) Chrissie Wright (Editor) : Handbook of Practical Communication Skills, Jaico Publishing House.
- 5) Dr. Nageshwar Rao & Dr. Rajendra P. Das : Communication skills, Himalaya Publisher House.

#### **6IE09 Communication Skills Lab:**

**Objective:** On completion of this laboratory the candidate should be able to demonstrate adequate skills in oral and written communication for technical English language actively participate in group discussions and interviews and exhibit the evidence of vocabulary building. Candidates should be assessed through continuous monitoring and evaluation. The sample list of experiments is given below. This list can be used as guideline for problem statements but the scope of the laboratory should not be limited to the same. Aim of the list is to inform about minimum expected outcomes.

1. Assignments and tests for vocabulary building
2. Technical report writing
3. Group discussions
4. Interview techniques
5. Projects and tasks such as class news letter
6. Writing daily diaries and letters
7. Interactive language laboratory experiments.

**TEXT BOOK:** Norman Lewis: Word Power Made Easy

**DRAFT SYLLABUS  
PRESCRIBED FOR  
B.E.(BIOMEDICAL ENGINEERING)  
SEMESTER PATTERN (CREDIT GRADE SYSTEM)  
SEMESTER V & VI  
FIFTH SEMESTER**

#### **5 BM 01 DATA STRUCTURES & ALGORITHMS**

**Unit I :** Data structures basics, Mathematical/algorithmic notations & functions, Complexity of algorithms, Sub algorithms. String processing: storing strings, character data type, string operations, word processing, and pattern matching algorithms.

**Unit II :** Linear arrays and their representation in memory, traversing linear arrays, inserting & deleting operations, Bubble sort, Linear search and Binary search algorithms. Multidimensional arrays, Pointer arrays. Record structures & their memory representation. Matrices & sparse matrices.

**Unit III :** Linked lists and their representation in memory, traversing a linked list, searching a linked list. Memory allocation & garbage collection. Insertion deletion operations on linked lists. Header linked lists, Two- way linked lists.

**Unit IV :** Stacks and their array representation. Arithmetic expressions: Polish notation. Quick sort, an application of stacks, Recursion. Tower of Hanoi problem. Implementation of recursive procedures by stacks, Queues. Dequeues. Priority queues.

**Unit V :** Trees, Binary trees & and their representation in memory, Traversing binary trees. Traversal algorithms using stacks, Header nodes: threads. Binary search trees, searching, inserting and deleting in binary trees. Heap and heap sort. Path length & Huffman's algorithm. General trees.

**Unit VI :** Graph the <j>ry, sequential representations of graphs, Warshalls' algorithm, Linked representation, operations & traversing the graphs. Po sets & Topological sorting. Insertion Sort, Selection Sort. Merging & Merge-sort, Radix sort, Hashing.

#### **Text book :**

Seymour Lipchutz: "Theory & Problems of Data Structures"  
Schaum's Outline series(TM).

#### **References:**

1. Ellis Horowitz, Sartaj Sahni - Fundamentals of Data Structures (CBS Publications)
2. Trembley, Sorenson:- An Introduction to Data Structures with Applications.(TMH)

3. Aho Ullman: Analysis and Design of Algorithms.(Pearson)
4. Bhagat Singh, Naps: Introduction to Data Structures. (Galgotia)

### 5BM02 BIO CONTROL SYSTEM

#### Unit I : CONTROL SYSTEM MODELLING

System concept, Differential Equations, Transfer functions, Modelling of electrical systems, Translational and rotational mechanical systems, Electto-mechanical systems, physiological systems, block diagram modelling, signal flow graphs.

#### Unit II : TIME RESPONSE ANALYSIS

Time domain specifications, step and Impulse response analysis of first order and second order systems, steady state errors, stability, Routh-Hurwitz criteria, Root locus techniques, construction of root locus, stability, dominant poles, applications of Root locus diagram.

#### Unit III :FREQUENCY RESPONSE ANALYSIS

Frequency response, Bode plot-Nyquist plots, Nyquist stability criterion, Relative stability, Gain margin, phase margin, bandwidth magnitude plots, constant circles, Nichol's chart

#### Unit IV: PHYSIOLOGICAL CONTROL SYSTEMS

Introduction to physiological control systems, modelling of human movements, parameter estimation, linearizing

#### Unit V : STUDY OF BIOLOGICAL SYSTEMS

Human Thermal system, Neuro muscular system, Respiratory system, oculomotor system.

**Unit VI:** State space representation of systems, conversion of state variable models to transfer functions,conversion of transfer functions to state variable models, solution of state equations, concepts of controllability and absorbability.

#### Books:

1. M.Gopal, 'Control Systems', Principles and Design, Tata McGraw-Hili, 1997.
2. Benjamin. C.Kuo, ' Automatic Control Systems', Prentice Hall of India, 1995.
3. Manfrecllyner and J.,hn H.Milsum, Bio Medical engineering system, McGraw-Hili and Co., Neo York, 1970.

### 5BM03 BIO MEDICAL INSTRUMENTATION

**Unit I :** Introduction to Biomedical Instrumentation Sources of biomedical potentials Electrical activity of excitable cells .

Resting and action potential Bioelectric potentials. Origin of bioelectric signals like ECG, EEG, EMG.

**Unit II :** Biopotential electrodes Basic electrode theory Nerenst equation Electrical conductivity of electrode jellies and cream Skin contact impedance and its measurement Electrodes for ECG, EEG and EMG. Recording electrodes

**Unit III:** Cardiovascular systems Physiology of heart ECG lead configuration Blood Pressure Characteristics of blood flow Measurement of blood flow and cardiac output.

**Unit IV :** Nervous system Classification of Nervous system Anatomy of Nervous system Organisation of Brain Neuronal communication Neuronal receptors Sematic and Autonomic nervous system Spinal reflexes. Neuronal firing measurements EEG measurement

**Unit V:** Measurement of Respiratory system Modeling the respiratory system Measurement of Gas Flow rate Measurement of Pressure Respiratory Plethysmography Measurement of Gas concentration Measurement of Oxygen concentration

**Unit VI:** Physiological effects of Electricity Leakage current, Types of leakage current Macroshock Hazards Microshock Hazards Electrical safety analysis Basic approaches to protection against shock Protection : Power Distribution Protection : Equipment Design

#### BOOKS:

- 1) R.S.Khandpur : Biomedical Instrumentation
- 2) Cromwell : Biomedical Instrumentation
- 3) John G. Webstar. : Biomedical Equipments

### 5BM04 COMMUNICATION ENGINEERING

**Unit I :** AM Transmitters : Modulation, need of modulation, AM Modulation, Frequency spectrum, Principles of DSB-FC, DSBSC, SSB-SC modulation and their comparison, Details of DSBFC Transmitter, Generation of DSB-SC by using balanced modulators (FET & Diodes), DSB-SC Transmitter. Generation of SSB-SC by phase-shift method.

**Unit II :** AM Receivers : TRF receiver, Superhetrodyne receiver, Details of each block such as RF amplifier, mixer oscillator, IF amplifier, Diode detector, Audio Amplifier. Need and type of AGC, Practical Radio Receiver Circuit with AGC, Characteristics such as selectivity, sensitivity, fidity communication receiver.



**Unit III :** FM Transmitters : FM Modulation, Frequency Spectrum, Circuits & Analysis for direct FM generation using FET and varactor diode. Circuit & analysis of Indirect FM generation, Narrow Band and Wide Band FM, their comparison, Deemphasis and pre-emphasis. FM Transmitter & stereo FM Transmitter.

**Unit IV :** FM Receivers : Details of FM receiver, blocks such as R.F. amplifier, local oscillator, IF amplifier, Mixer, Audio Ampl., AGC, Limiter, FM Discriminator, Single Slope and Balanced slope detector, Analysis of Foster seeley and ratio detectors, Stereo FM receiver.

**Unit V :** Monochrome TV : Basic television system, simultaneous sound and picture transmission, scanning process, composite video signal, signal transmission and channel bandwidth, camera tubes, TV receiver; Block diagram and functional requirements, Basic concept of colour TV.

**Unit VI:** Satellite Communication : Orbital satellites, Geostationary Satellites, Orbital patterns, Look angles, satellite system link models, Transponder, Up link, Down link, cross link, satellite system parameters, Radiated power.

#### **BOOKS :**

- 1) Kennedy G. : Electronics Communication System, Tata McGraw Hill Co., New Delhi (Third Edition), 1985.
- 2) Young P.H. : Electronics Communication Techniques, Coloumbus, A Bell and Howell Co. (First Edition)
- 3) Martin James : Telecommunication and the Computer, Prentice Hall Inc. New Jersey (Third Edition), 1972.
- 4) Roddey D., Coolen S. : Electronics Communication, Prentice Hall India Pvt. Ltd. (Third Edition), 1983.

### **Free Elective- I**

#### **5FEBM05 (i) MEDICAL INSTRUMENTATION**

##### **Unit I: PHYSIOLOGY AND TRANSDUCERS**

Cell and its structure – Action and resting – Potential propagation of action potential – Sodium pump – Nervous system – CNS – PNS – Nerve cell – Synapse – Cardio pulmonary system – Physiology of heart and lungs – Circulation and respiration – Transducers – Different types – Piezo-electric, ultrasonic, resistive, capacitive, inductive transducers – Selection criteria.

##### **Unit II : ELECTRO – PHYSIOLOGICAL MEASUREMENTS**

Basic components of a biomedical system – Electrodes – Micro, needle and surface electrodes – Amplifiers – Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier. ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms.

##### **Unit III: NON-ELECTRICAL PARAMETER MEASUREMENTS**

Measurement of blood pressure – Cardiac output – Cardiac rate – Heart sound – Respiratory rate – Gas volume – Flow rate of Co<sub>2</sub>, o<sub>2</sub> in exhaust air - PH of blood, ESR, GSR measurements – Plethysmography.

##### **Unit IV : MEDICAL IMAGING AND PMS**

X-ray machine - Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Different types of biotelemetry systems and patient monitoring – Electrical safety.

##### **Unit V : ASSISTING AND THERAPEUTIC EQUIPMENTS 9**

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dializers.

##### **Unit VI: BLOODFLOW AND BLOOD CELL COUNTING 9**

Electromagnetic and ultrasonic blood flowmeter, indicator dilution method, thermodilution method, manual and automatic counting of RBC, WBC and platelets.

#### **Text Books :**

1. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, 'Bio-Medical Instrumentation and Measurements', II Edition, Pearson Education, 2002 / PHI.
2. R. S. Khandpur, 'Handbook of Bio-Medical instrumentation', Tata McGraw Hill Publishing Co Ltd., 2003.

#### **Reference Books :**

1. M. Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.
2. L.A. Geddes and L.E. Baker, 'Principles of Applied Bio-Medical Instrumentation', John Wiley & Sons, 1975.
3. J. Webster, 'Medical Instrumentation', John Wiley & Sons, 1995. 4. C. Rajarao and S.K. Guha, 'Principles of Medical Electronics and Bio-medical Instrumentation', Universities press (India) Ltd, Orient Longman Ltd, 2000.

**Free Elective - I**  
**5FEBM05 (ii) PRINCIPLES OF BIOMATERIALS**  
**AND BIOMECHANICS**

**Unit I : INTRODUCTION TO DIFFERENT TYPES OF BIOMATERIALS:**

Polymers, Plastics, Metallic and Ceramic Materials, Carbon and Polymers, Absorbable and Porous Biomaterials. Surface chemistry of biomaterials, thermal and chemical phenomenon,

**MECHANICAL PROPERTIES AND TESTS:**

For elasticity, plasticity, inelasticity, desolation, deformation and fracture

**Unit II : POLYMER AND PLASTICS :**

Classification, thermal properties, factor influencing polymer properties. Polymer compatibility, polymer degradation, restorable polymers, tissue adhesives.

**METALLIC AND CERAMIC BIOMATERIALS**

Properties and use to titanium alloys stainless steel, cobalt based alloys, degradable ceramics Carbon and polymeric biomaterials: Carbon, polythene, polypropylene, silicones rubber, acrylic implants, hydro gels.

**Unit III : DENTAL IMPLANTS:**

Alveolar bone replacements, orthopedic implants – types of orthopedic function devices, permanent joint replacements, hip joints, bone cement, biological testing of biomaterials

**Unit IV : GENERAL PRINCIPLES OF BIOMECHANICS :**

Analysis of biological sub system from the biomechanical point of views and rise modelling. Cardio-vascular and pulmonary mechanics. Rheology of blood circulation System . Mechanics of heart valves and heart assist devices Instrumentation .

**TISSUE BIOMECHANICS:**

Direct, shear, bending and torque actions, and the corresponding stresses and strains in biological tissues. Stress relaxation and torque actions, and the corresponding stresses and strains in biological tissues. Stress relaxation and creep, stability and instability.

**Unit V : MOVEMENT BIOMECHANICS:**

Gait Analysis, body and limb mass and motion characteristics, muscle actions, forces transmitted by joints. Joint forces results in the normal and disabled human body. Slow normal and fast gait on the level. Strain and ramp ascent and descent. Joint replacements.

Classification in Prosthetics and Orthotics Lower Extremity orthoses and prostheses Positions of anatomical axis and corresponding movements of the body part. Material Technology in Prosthetics and Orthotics.

**Unit VI : PRINCIPLES IN DESIGNING ORTHESIS AND PROSTHESES**

Principles of three point pressure, total contact, partial weight relieving etc. Positions of anatomical axis and corresponding movements of the body part International conventions with respect to above. Purpose for providing prostheses and Orthoses.

**BOOKS :** Clinical biomechanics Zeevi Dvir Churchill Livingstone, 2000 - Medical Principles of biomechanics & motion analysis Iwan W. Griffiths Lippincott Williams & Wilkins, 2006 -

Biomechanical analysis of fundamental human movements Arthur E. Chapman Human Kinetics, 2008

1. Biomaterials An Introduction Park, Joon, Lakes, R. S. 3rd ed., 2007

**5BM06 PATHOLOGY & MICROBIOLOGY**

**Unit I : NORMAL CELL STRUCTURE :**

Cell Degeneration and regeneration - Inflammations, apoptosis, Neoplasia. Classification, Difference between benign and malignant. Etiology of tumors - Spread of Tumors.

**Unit II : FLUID AND HAEMODYNAMIC DERANGEMENT**

Edema, Shock, Hemorrhage - Thrombus - Embolism – Disseminated intra vascular Coagulation - Hematological disorders. Bleeding Disorders - Leukemia - lymphoma.

**Unit III : GENETIC DISORDERS, INFECTION AND IMMUNITY:**

Autosomal and Sex linked disorders - Storage disorders - Types of hypersensitivity reactions - Immune deficiency Syndrome - Primary - HIV - Viral disease. Chlamydial – Bacterial - mycoplasma - Rickettsial disease - Fungal, protozoal. - Helminthic disease.

**Unit IV:** General Structural Organization of Bacterial, Viral Cell- Growth and Identification of Bacteria, Observation of culture. Microscopy: - Light Microscopy - Dark field Microscopy -Phase contrast microscopy -electron microscopy.

**Unit V :** Identification of disease producing organism, Simple Stain, Gram Stain, AFB Stain, Fluorescent techniques, Antigen-Antibody Technique

**Unit VI: CARDIO VASCULAR DISEASES**

Ischaemic Heart Disease Rheumatic heart Disease Valvular Heart Disease Hypertension Cardiomyopathy Infective Endocarditis. Congestive Cardiac Failure Diseases of Pericardium. - Cardiogenic Shock.

**TEXT BOOKS :**

1. Robbins S.L & Ramzi S.C, "Pathologic Basis of Diseases", W.B. Saunders Co. 1999
2. Anatha Narayanan.R & Jayaram Panicker C.R, 'Text Book of Microbiology, Orient Laongman' 1998.

**5 BM07 DATA STRUCTURES & ALGORITHMS- LABORATORY**

The sample list of program is given below. This list can be used as guide line for problem statements but the scope of the laboratory should not be limited to the same. Aim of the list is to inform about minimum expected outcomes.

1. Write an application to implement Tower of Hanoi Problem Algorithm.
2. Write an application to implement Abstract data type stack.
3. Write an program to evaluate Post fix expression using stack.
4. Write a program to implement Abstract data type queue.
5. Write a program to implement singly linked list that performs various operation such as insertion. deletion, searching a node in linear linked list.
6. Write a program to implement Preorder Traversal of a binary tree.
7. Write a program to search a given element using Binary Search.
8. Write a program to implement Selection Sort.
9. Write a program to implement Merge Sort.
10. Write a program to perform insertion or search in a specified level of a stack implemented tree-structured symbol table.

**5BM08 BIOMEDICAL INSTRUMENTATION LAB**

**Practicals:** Minimum Eight Practical's based on Syllabus.

**5BM09 COMMUNICATION ENGINEERING LAB**

**PRACTICALS:** Minimum 8 practicals based on syllabus, preferably uniformly distributed.

**SIXTH SEMESTER****6BM01 DIAGNOSTIC & THERAPEUTIC EQUIPMENTS****DIAGNOSTIC EQUIPMENT**

**Unit I :** Introduction to Biomedical Recorder ECG recorder, Microprocessor based ECG machines, Multichannel ECG machine Vector cardiograph, phono cardiograph, Heart sound EEG recorder, EMG recorder

**Unit II :** Medical Imaging System Instrumentation for diagnostic X-Ray Properties of X-Ray units, X-Ray machines and generation process Special imaging techniques for X-Rays Computed Radiography, Computed Tomography  
Ultrasonic imaging system, Physics of ultrasound Basic modes of transmission Ultrasonic display modes - Ascan, Bscan, Mscan with applications, Ultrasonography

**Unit III:** Patient Monitoring system System concept Bedside patient monitors Central monitors Average reading heart monitor Intensive care monitoring Ambulatory monitoring Biotelemetry: Single channel & multichannel telemetry, telephone & computer based telemetry .

**THERAPEUTIC EQUIPMENTS**

**Unit IV:** Cardiac Pacemaker, Types of Pacemaker External Pacemaker Implantable Pacemaker, Types & Implantable Pacemaker Leads & electrodes, pacing system analyser Ventricular synchronous demand Pacemaker Programmable Pacemaker Reliability aspects of cardiac Pacemaker Power sources of implantable Pacemaker

**Unit V:** Cardiac Defibrillator DC – defibrillator Defibrillator electrodes Defibrillator analyser Implantable Defibrillator Cardioverters Ventilators, High frequency ventilators Muscle stimulator Unit

**Unit VI:** Physiotherapy & Electrotherapy equipment Shortwave diathermy machine Microwave diathermy machine Ultrasonic therapy unit Therapeutic apparatus Surgical diathermy machine Electrodes used with surgical diathermy Infant incubators Therapeutic application of laser

**Text Books:**

- 1) R.S.Khandpur: Handbook of Biomedical Instrumentation, TMH Pub.
- 2) Cromwell L., Wibell F. w., Pfciffer E.A. : Biomedical Instrumentation & Measurements, PHI Pub.

3) Timpkins W.J. : Biomedical Digital Signal Processing.

**Reference Books :**

- 1) Carr & Brown: Introduction to Biomedical Equipment.
- 2) Webster J.G. : Medical Instrumentation, 3rd edition, John Wiley.

**6BM02 MICROPROCESSORS AND APPLICATIONS**

**Unit I :** 8086 architecture and pin configuration, Software model of 8086 microprocessor. Memory addresses space and data organization. Data types. Segment registers, mem(i)ry segmentation. IP & Data registers, Pointer, Index registers. Memory addresses generation.

**Unit II :** 8086 Instruction set overview, addressing modes. 8086 instruction formats. 8086 programming : Integer instructions and computations: Data transfer instructions, Arithmetic instructions and their use in 8086 programming.

**Unit III:** 8086 programming: logical instructions. Shift and rotate instructions and their use in 8086 programming. 8086 flag register and Flag control instructions, compare instruction, control flow and jump instructions, Loops & loop handling instructions. 8086 programming using these instructions.

**Unit IV:** The 8086 stack segment and stack related instructions. 8086 I/O Address space. Subroutines and related instructions, Parameter passing, Concept of Macros, Status saving on stack. Concept of recursion at assembly program level. 8086 Programming using subroutines, recursion and macros.

**Unit V:** 8086 I/O: Types of input output, isolated I/O interface. Input output data transfers, I/O instructions and bus cycles. Programmable Peripheral Interface 8255 PPI: pin diagram, internal organization, modes of operation. 8086 I/O programming using 8255.

**Unit VI:** 8086 Interrupts types, priority and instructions. Interrupt vector table, External hardware-interrupt interface signals & interrupts sequence. Software interrupts. Non-maskable interrupts. Programmable Interrupt Controller 8259: pin diagram, internal organization, modes of operation. 8086 Interrupt-driven programming using 8259.

**TEXT BOOKS:**

1. W. A. Triebel & Avatar Singh: The 8088/8086 Microprocessors (4e) (PHI /Pearson Education)
2. Liu & Gibson: The 8088/8086 Microprocessor (2/e) (PHI)

**REFERENCE BOOKS:**

1. Barry B. Brey : The Intel Microprocessor Architecture, Programming & Interfacing (6/e)(PHI)
2. Ray & Bhurchandi: Advanced Microprocessors & Peripherals (TMH). 3. John P Uttenbeck, "8086/8088 Families: Designing, Programming and Interfacing". Prentice Hall .

**6BM03 RADIOLOGICAL EQUIPMENTS**

**Unit I :** X-Rays: principles and production of soft and hard X-rays, selection of anodes, Heel pattern, scattered radiation. Porter Bucky system, Cooling system, Origin and nature of X-rays and nuclear medicine equipment, Types and uses of X-ray. Nature and types of Nuclear radiation. Block diagram and operation of X-ray machine

**Unit II :** Radio-diagnosis Radiography. Angiography, Fluoroscopy, Image intensifier, Multi section radiography, Instrumentation for the medical use of radioisotopes. Units for measuring radioactivity, Nuclear medicine machine, Computer system used in X-ray & Nuclear medicine equipment.

**Unit III :** Special Radiological Equipment: principle, plane of movement, multi section radiography, CAT, principle of NMR, MRI, Image reconstruction techniques, basic NMR components, applications, Advantages & disadvantages of NMR, Imaging techniques, Biological effects of NMR imaging computed tomography, computed radiography.

**Unit IV :** Application of Radioisotopes : Alpha, Beta and Gamma emission, principle of radiation detectors, dot scanners, Nuclear Angiogram, principles of radiation therapy, radiation thermometry, radiation sources, radiation sensors.

**Unit V :** Medical Ultrasonography: Ultrasound, Physics of sound and ultrasound waves, ultrasound transducer, scan modes and scanning systems, Biological effects of ultrasound. Flow meters, ultrasonic blood pressure measurement, ultrasonic scanner.

**Unit VI :** Radiation Safety: Hazardous effect of radiation. Radiation protection techniques, Safety limits radiation monitoring.

**TEXT BOOKS:**

- 1) R.S.Khandpur : Handbook of Biomedical Instrumentation
- 2) Carr and Brown : Biomedical Instrumentation (3) Steve Webb : The Physics of Medical Imaging.

**6BM04 PHYSIOLOGICAL MODELLING & SIMULATION**

- Unit I :** Introduction to physiological control systems, Art of modelling physiological systems, Linear models of physiological systems, distributed parameters versus lumped parameter models. Principle of superposition.
- Unit II :** Cardiovascular system modeling and simulation: Theoretical basis, model development, heart model, circulatory model. Computational flow diagrams of cardiac system. Software development.
- Unit III :** Pulmonary mechanics modeling & simulation: Theoretical basis, model development, lung tissue viscoelastance, chest wall, airways-full mode I of respiratory mechanics, Pulmonary system software development - computational flow diagram.
- Unit IV:** Interaction of Pulmonary and cardiovascular models, computational flow diagram for cardiopulmonary, software development, Eye movement system, Oculomotor muscle model and linear muscle model.
- Unit V :** Simple models of muscle stretch reflex action, Ventilatory control action, lung mechanics and their simulink implementation. Frequency domain analysis of linearized model of lung mechanics, circulator control model and glucose insulin regulation model by MATLAB Tool.
- Unit VI:** Study of steady state analysis of muscle stretch reflex action. Ventilatory control action by MATLAB tools. Study of transient response analysis of neuromuscular reflex model action by MATLAB tools.

**TEXT BOOKS:**

- 1) Michael C.K.Khoo: Physiological Control System: Analysis Simulation & Estimation
- 2) Jon B. Olansen & Eric Rosow : Virtual Bioinstrumentation, Biomedical, Clinical and Health Care Application.

**Free Elective – II****6FEBM05 (i) MODELING AND SIMULATION**

- Unit I : Physiological Modeling :**  
Steps in Modeling, Purpose of Modeling, lumped parameter models, distributed parameter models, compartmental modeling, modeling of circulatory system, regulation of cardiac output and respiratory system.

**Unit II : Model of Neurons :**

Biophysics tools, Nernst Equation, Donnan Equilibrium, Active Transport ( Pump) GHK equation, Action Potential, Voltage Clamp, Channel Characteristics, Hodgkin- Huxley Conductance Equations, Simulation of action potential, Electrical Equivalent model of a biological membrane, impulse propagation- core conductor model , cable equations.

**Unit III : Neuromuscular System:**

Modeling of skeletal muscle, mono and polysynaptic reflexes, stretch reflex, reciprocal innervations, two control mechanism, Golgi tendon, experimental validation, Parkinson's syndrome.

**Unit IV :Eye Movement Model:**

Four eye movements, quantitative eye movement models, validity criteria.

**Unit V : Thermo regulatory systems:**

Thermoregulatory mechanisms, model of thermoregulatory system, controller model, validation and application.

**Unit VI :Modelling the immune response:**

Behaviour of the immune system, linearized model of the immune response., Pharmacokinetics Drug delivery

**Text Books:**

1. Bioengineering, Biomedical, Medical and Clinical Engg.: A.Teri Bahil.
2. Signals and systems in Biomedical Engg.: Suresh R Devasahayam.
3. Bio-Electricity A quantitative approach by Barr and Ploncey

**Reference Book:**

1. Biomedical Engineering Handbook by Bronzino (CRC Press)

**Free Elective – II****6FEBM05 (ii) BIOMEDICAL IMAGE PROCESSING**

- Unit I : Basics of Image processing:** Image acquisition, Processing, communication, display, Electromagnetic Spectrum, Visual perception, structure of the human eye, image formation in the eye, uniform and Non-Uniform Sampling, Quantization, Image formats

- Unit II : Image Enhancement:** Spatial Domain-Point processing techniques, histogram processing, Neighbourhood processing, Frequency Domain techniques- 2D-DFT, Properties of 2 D-DFT, Low pass, High pass, Noise removal, Homomorphic filters, Basics of Colour image processing

**Unit III :Image Segmentation:** Detection of discontinuities, point line, edge detection, Edge linking, Hough transform, Region Based segmentation

**Unit IV: Image transforms:** DFT, FFT, DCT, DST, Hadamard, Walsh, Haar, Slant, K-L Transforms, Basis Functions and basis images

**Unit V : Image Compression:** Fundamentals of Image compression models, Lossless Compression- RLE, Huffman, LZW, Arithmetic coding techniques Lossy Compression- IGS coding, Transform coding, JPEG, Predictive Coding.

**Unit VI: Representation and Description:** Morphology-dilation, Erosion, open, close, Hit and miss, Boundary extraction, region filling, skeletonization, Feature extraction, Moments

#### Text Books:

1. Digital Image Processing, Gonzalez and Woods- Pearson Education
2. Fundamentals of Digital Image Processing, A.K. Jain .P.H.I.
3. Digital Image Processing and Analysis, Chanda Majumder- Printice Hall India.

#### Reference Books:

1. Digital Image Processing and Computer Vision, Sonka, Hlavac,Boyle- Cenage learning.
2. Digital Image Processing, William Pratt- John Wiley

### 6BM06 COMMUNICATION SKILLS

**Unit I :** Comprehension over an unseen passage. Comprehension - A - word study :- Synonym, antonym, meanings, matching words, adjectives, adverbs, prefix and suffix, correct forms of commonly misspelled words, understanding of the given passage.

Comprehension - B - Structure study :- Simple and compound sentences, types of conjunctions, singular and plural, tenses and their effect on verb forms. Use of - not only - but also, if clause, since, may, can, could, would, too etc.

Active and passive forms, negative and interrogative, punctuation and capitalization.

**Unit II :** Theoretical background - importance of communication, its process, model of communication its components & barriers. Verbal communication, its significance, types of written communication, organization of a text (Titles, summaries, headings, sequencing, signaling, cueing etc.), Important text factors (length of paragraph, sentences, words, clarification and

text difficulty). Evaluation of written communication for its effectivity and subject content.

Non-verbal communication, types of graphics and pictorial devices.

**Unit III :** Specific formats for written communication like – business correspondence, formal reports, technical proposals, research papers and articles, advertising and graphics. Format for day-to-day written communication like applications, notices, minutes, quotations, orders, enquiries etc. Oral communications - Important objectives of interpersonal skills, (verbal and non-verbal), face to face communications, group discussion and personal interviews.

Methodology of conduction of meetings, seminars, symposia, conference and workshop.

#### BOOKS RECOMMENDED :

- 1) Krishna Mohan, Meera Banerjee : Developing Communication Skills, MacMillan India Limited.
- 2) Chrissie Wright (Editor) : Handbook of Practical Communication Skills, Jaico Publishing House.
- 3) Curriculum Development Centre, TTTI WR, Bhopal : A Course in Technical English, Somaiya Publication Pvt. Ltd.
- 4) F.Frank Candlin : General English for Technical Students, University of London Press Ltd.
- 5) Barunk Mitra, Effective Technical Communication, Oxford University Press
- 6) Meenakshi Raman & Sangeeta Sharma, Technical Communication Principles & Practice, Oxford University Press

### 6BM07 MICROPROCESSORS AND APPLICATIONS - LABORATORY

The sample list of program is given below. This list can be used as guide line for problem statements but the scope of the laboratory should not be limited to the same. Aim of the list is to inform about minimum expected outcomes.

Write a program in TASM to manipulate the two given operands with general arithmetic operators +, -, \*, / and store the result at the given location 2000H to 2003H respectively. . Write an instruction sequence that generates a byte size integer in the memory location defined as RESULT. The value of the integer is to be calculated from logical equation [RESULT] = [AL] \* [NUM 1]+ [NUM2] \* AL + BL . Assume that all parameters are byte- sized. NUM 1, NUM2 and RESULT are the offset addresses of the memory location in the current data segment.

Given a number XY, write a program using TASM to store OX in BX register and OY in ex register. . Write a TASM program to sort the elements using Bubble Sort Algorithm. . Write a program in TASM to search for a single item from a list of elements using Binary Search Algorithm. Show that if the element is found or not. . Write a program in TASM to convert the given binary number into decimal number. The unsigned eight-bit value is stored in variable BINV AL; the three-digit ASCII result is stored in three memory locations HUN, TEN & ONE. . Given 16-bit binary number in OX, write a program that converts it into its equivalent BCD number. If result is bigger than 16-bit, place aliI's in OX . Write a program using TASM by using DOS INT 2 I H, function 09H to display string. The string to be displayed must have a '\$' as its last character. The string address of the string must be loaded into register OX and the string must reside within current data segment. . Write a program using TASM to echo command line text to the screen using INT 21 H, function 02H. . Write a program using TASM to read the date maintained by the system and return the following information using DOS INT 2 I H, function 2AH.DH = Month DL = Day of month CX=Year AL=Day of the week Using DOS INT 21 H function 08H write a program in TASM to obtain a secret Password from user. The password is not echoed to the screen. The password is stored in PWTXT and may be of any length, but must be terminated by a carriage return.

### **6BM08 PHYSIOLOGICAL MODELLING & SIMULATION - LAB**

**Practicals :** Minimum Eight Practicals Based on syllabus.

### **6BM09 COMMUNICATION SKILLS - LABORATORY**

#### **Objective:**

- On completion of this laboratory the candidate should be able to demonstrate adequate skills in oral and written communication for technical English language, actively participate in group discussions and interviews and exhibit the evidence of vocabulary building. Candidates should be assessed through continuous monitoring and evaluation.
- The sample list of experiments is given below. This list can be used as guideline for problem statements but the scope of the laboratory should not be limited to the same. Aim of the list is to inform about minimum expected outcomes.
  1. Assignments and tests for vocabulary building
  2. Technical report writing
  3. Group discussions
  4. Interview techniques
  5. Projects and tasks such as class news letter

6. Writing daily diaries and letters

7. Interactive language laboratory experiments.

**TEXT BOOK :** Norman Lewis : Word Power Made Easy

<http://www.teachingenglish.org.uk>

### **6 BM 10 MEDICAL INSTRUMENTATION - LAB.**

Lab. based on 6BM01 Diagnostic & Therapeutic Equipments and 6BM03 Radiological Equipments.