POST GRADUATE STUDIES REGULATIONS

and

COURSE DESCRIPTION

(SECTION- I & II)

M.Tech. and Ph.D.

Effective from 2016-17

COLLEGE OF TECHNOLOGY AND ENGINEERING
MAHARANA PRATAP UNIVERSITY OF AGRICULTURE & TECHNOLOGY
UDAIPUR (Rajasthan) 313001

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VISION & MISSION OF THE INSTITUTE

VISION

To create an institute of technical education of international standards and conducting research at the cutting edge of technology to meet the current and future challenges of technological developments.

MISSION

- Promise excellence, foster high standard and orient the educational program towards future needs and opportunities through strong Academia-Industry-Stakeholders linkages.
- Strengthen the curricula and add frontier engineering areas such as information and communication technology, environmental engineering, precision farming, energy conservation, dimensional stone technology, robotics, artificial intelligence, instrumentation and control.
- Provide opportunities for post doctoral research, continuing education, faculty up gradation and development of human resources in new and cutting edge technological areas especially through international collaboration.
- Strengthen non-formal training to promote entrepreneurial skills and commercialization of agriculture and promote client oriented on-farm research and technological assessment, refinement and transfer through participatory approaches by promoting the institute Village Linkage Program.

POST GRADUATE STUDIES REGULATIONS

(SECTION-I)

M. Tech. and Ph.D.

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COLLEGE OF TECHNOLOGY AND ENGINEERING

MAHARANA PRATAP UNIVERSITY OF AGRICULTURE & TECHNOLOGY
UDAIPUR (Rajasthan) 313001

SECTION- I

ACADEMIC REGULATIONS
(POST GRADUATION COURSES)

UPDATED RULES AND REGULATIONS FOR POST GRADUATE STUDIES (2015)

The students admitted shall be governed by the relevant rules as indicated below and amendments made from time to time in future.

1.0 DEFINITIONS

1.1 "Academic Year" or "Academic Session" of the University shall ordinarily be between July to June and shall consist of two semesters.

1.2 "Semester" is an academic term of normally 110 days including examinations (with a minimum of 16 weeks of instructional days).

1.3 "Course" means a unit of instruction or a segment of a subject matter to be covered in a semester. Each course is assigned a specific number, title and credits.

1.4 "Credit Hour" also written as "Credits" imply that each credit hour will represent an hour of lecture or two to three hours of laboratory / field practical each week in a semester.

1.5 "Grade Point" is a numerical number which denotes student's performance in a course.

1.6 "Credit Point" is the product of credit hours and grade point obtained by the student in a course.

1.7 "SGPA" (Semester Grade Point Average) is the average of the credit points of a semester.

1.8 "OGPA" is the overall cumulative grade point average obtained by the student in the courses taken in all the semesters completed by him / her.

$$\text{OGPA} = \frac{\text{Sum of the products of grade point earned and credit hours of all the courses offered}}{\text{Sum of the credit hours of all the courses offered}}$$

1.8.1. For obtaining equivalent percentage of OGPA under 10 point scale, the OGPA will be multiplied by factor 10 (Ten). The division of Post Graduate students shall be determined by the OGPA at the end of successful completion of programme as follows-

OGPA	**Division**
6.50-6.99	II- Division
7.00-7.99	I- Division
8.00 and above	I- Division with distinction

Further, the OGPA, at the end of the programme will be calculated up to third decimal digit but will be awarded up to two decimal digits. However in case, third decimal digit is 5 or above, the OGPA will be rounded to next higher digit i.e. an OGPA of 6.995 and above will be considered as 7.00.

1.8.2 Conversion of OGPA into percentage or vice-versa:

A. Percent of marks obtained under traditional system be converted to OGPA under 10 point scale by dividing it by 10 (ten).

B. OGPA obtained under grading system (like 4 or 5 point scale etc.) be converted to OGPA in 10 point scale or the percentage using following formulae:

(i) OGPA under 10 point scale = 9G / N

(ii) Percentage of marks = 90G / N

Where G is the OGPA under grading system and N is the value of scale like 4 in 4 point scale, 5 in 5 point scale and likewise.

1.9 "Year" means an academic session consisting of two semesters. Say, first year means the first academic session of the prescribed course of a degree programme. Similarly, second year, third year, and fourth year mean second, third and fourth academic session, respectively.

1.10 The University awards medals to meritorious students of which details are as follows-

A. Chancellor's Gold Medal

This is the highest honour bestowed on one meritorious student in the field of academics every academic year starting from 2016-17. The Chancellor's Gold Medal will be given each year in any one faculty at Post-graduate level by rotation. The student obtaining highest OGPA in any faculty across the department will be awarded Chancellor's Gold Medal. The rotation of the faculty will be on the alphabetical order i.e. Agriculture, Engineering & Technology, Fisheries and Home Science. A student being awarded University Gold Medal, if found eligible will also be awarded Chancellor's Gold Medal.

B. University Gold Medal

Ph.D. Degree Programme- One Gold Medal for Ph.D. degree programme in the faculty of Engineering & Technology. For Rules and Guidelines for award of Gold Medal refer *Appendix XXIV.*

Master's Programme- For awarding Gold Medal at least three candidates should have completed the degree and that the candidate, who has been selected for award of Gold Medal, should possess a minimum OGPA of 7.5. The Gold Medals should be awarded on the basis of academic performance in each discipline.

C. Jain Irrigation Medal

'Jain Irrigation Medals' sponsored by M/S Jain Irrigation Systems Ltd., Jalgaon (Maharashtra) are provided to the meritorious students of the University in the faculty of Engineering & Technology, as specified-

i) B. Tech. (Ag.)- 1 Medal
ii) M. Tech. (Ag.) Soil & Water Conservation Engineering- 1 Medal
iii) M. Tech. (Ag.) Irrigation and Water Management- 1 Medal
iv) Ph.D. (Ag.) Irrigation Water Management- 1 Medal

2.0. MAJOR FIELD OF STUDY

The following shall be the Degrees and Major Fields of Studies there-in to be awarded in Faculty of Technology & Engineering:

2.1 Master's Degree (M. Tech.)

Major fields of study:-

i. Farm Machinery & Power Engineering
ii. Soil & Water Conservation Engineering
iii. Irrigation Water Management Engineering
iv. Renewable Energy Engineering
v. Processing & Food Engineering
vi. Mining Engineering (Mine Planning)
vii. Mechanical Engineering (CAD/CAM)
viii. Electrical Engineering (Power Electronics)
ix. Electronics & Communication Engineering (Communication Engineering)
x. Computer Science & Engineering
xi. Civil Engineering (Structural Engineering)

2.2 Ph.D. Degree by course work

Major fields of study:-

i. Farm Machinery & Power Engineering
ii. Soil & Water Conservation Engineering
iii. Irrigation Water Management Engineering
iv. Renewable Energy Engineering
v. Processing & Food Engineering
vi. Electrical Engineering
vii. Computer Science & Engineering
viii. Electronics & Communication Engineering
ix. Mechanical Engineering
x. Mining Engineering

3.0 GENERAL ADMISSION RULES

3.1 Mode of admission:

i). Master’s programme – On the basis of valid GATE Score w.e.f. academic session 2017-18. In case of non-availability of GATE candidates, seats shall be filled on the basis of Merit cum Interview, as per the criterion fixed by the University.

ii). Ph.D. programme – Through Written Entrance Test w.e.f. academic session 2017-18 & subsequently on the basis of Merit cum Interview, as per the criterion fixed by the University.

3.2 For Master's programme, a candidate must possess a Bachelor's degree (B.E./B.Tech.), with minimum 60% or equivalent marks in respective/ related subject (as approved by Academic Council) for General and 55% for SC/ST/OBC/SBC (Non Creamy Layer).

3.3 For Ph.D. by course work programme, a candidate must possess a Master's degree in the respective/ related subject and faculty from MPUAT, Udaipur or a degree declared equivalent thereto from a recognized University or Institute with 6.50/10.00 or equivalent OGPA for General and 5% relaxation for SC/ST/OBC/SBC (Non Creamy Layer) candidates in Technology & Engineering.

3.4 Admission shall be open in the first semester of the academic year for Master's degree and Ph.D. degree.

3.5 No student shall be entitled to join more than one programme of studies concurrently anywhere.

3.6 Admission to any University programme can not be claimed by a candidate as a matter of right.

3.7 Admission committee may refuse admission to any candidate on valid ground(s) to be recorded. However, in case a person obtaining qualifying marks in pre-entry examination is refused admission by the admission committee, it would be after the candidate has been given a hearing by the admission committee. The candidate may file appeal to the Vice-Chancellor. Decision of the Vice-Chancellor shall be final.

3.8 An applicant suppressing or giving wrong information or facts or forging signature of parents or attaching false certificates shall forfeit admission in addition to any other punishment that may be awarded to him / her.

3.9 Candidate who applies under a reserved quota shall be considered as per existing State Government rules and amended from time to time, hereafter.

3.10 Following candidates shall not be given admission in the University or its constituent Colleges, even if they are qualified for it:-

a) A candidate against whom a FIR has been lodged by the University or any of the constituent colleges or by any other competent authority / officer of the University.

b) A candidate who has been convicted of a criminal offence or has been released on bail in connection with a criminal offence and against whom a case is pending in a court of law.

c) A candidate who has indulged in misbehavior with his Teacher / staff or with any authority of the University.

3.11 Foreign students are normally admitted under the category of ICAR nominee. No self-financing foreign student shall be given admission unless his case is supported either by the Government of India / International Organisations / respective Governments and approved by the ICAR provided they fulfill other prescribed qualifications and requirements.

3.12 Foreign students sponsored / nominated through ICAR shall be required to pay institutional economic fee as prescribed from time to time in addition to the normal fees charged by the College / University from Indian students.

3.13 Following categories of candidates are exempted from appearing in the written test:

i) Seats reserved under ICAR nominee.

ii) Candidates who have qualified for JRF and nominated by ICAR.

iii) Other sponsored candidates deputed by the MPUAT, Udaipur or the Government of Rajasthan.

3.14 Admission in M. Tech.* in faculty of Technology and Engineering shall be based on valid GATE Score w.e.f. academic session 2017-18. In case of non-availability of GATE candidates the seats shall be filled on the basis of Merit cum Interview, as per the criterion** fixed by the University as follows-

	Secondary	Sr. Secondary	UG (B.E./ B.Tech.)	GATE	Experience	Interview	Total
M.Tech.**	10% (10)	10% (10)	50% (50)	10% (10)	10% (10)	10% (10)	100% (100)

*As per Notification No. CTAE/Gen./2016/5051-57 dated 16.08.2016.
***As per letter no. F.MPUAT/DRI/ME/2008/1464 dated 20.08.2008.*

3.15 Admission in Ph.D.* in faculty of Technology and Engineering shall be through written (screening) test. Those candidates who score 50% or above marks in the written test shall only be eligible for admission based on merit-cum-interview as per the criterion** fixed by the University as mention below. The Sponsored candidates need not to appear in the written test.

	Secondary	Sr. Secondary	UG (B.E./B.Tech.)	PG (M.E./M.Tech.)	Experience	Interview	Total
Ph.D.**	10% (10)	10% (10)	30% (30)	30% (30)	10% (10)	10% (10)	100% (100)

*As per Notification No. CTAE/Gen./2016/5051-57 dated 16.08.2016.
***As per MPUAT/AC-36/2012-02/05.*

Note:

i) For admissions in Agricultural Engineering disciplines/branches, combined merit list shall be prepared for all the Agricultural Engineering disciplines/ branches namely FMPE, REE, SWE, IWM and PFE; as a student is eligible to apply in any branch of these.

ii) For experience, two marks for minimum one year of experience and thereafter for each additional year's or part of years' experience, two marks proportionately will be given, subject to maximum marks of ten. For consideration of experience, production of Form '16' from concerned organisations where the candidate has worked will be mandatory.

3.16 Eligibility qualifications for admission in faculty of Technology and Engineering: Master's Programme (M.Tech.) and Doctoral Programme (Ph.D.)

S.No.	Branch/Discipline	Specialization	Code	Seats	Qualifying Degree
Master of Technology (M.Tech.) Programs					
1.	Agricultural Engineering	Farm Machinery & Power Engineering	FMP	6	BE/B.Tech.(Ag./Mech.)
2.	Agricultural Engineering	Renewable Energy Engineering	REE	6	BE/B.Tech.(Ag./Mech./Elect./ Chemical/ Electronics/Civil/ Renewable Energy & Environmental Engg.)
3.	Agricultural Engineering	Soil & Water Conservation Engineering	SWC	6	BE/ B.Tech.(Ag./Civil)
4.	Agricultural Engineering	Irrigation Water Management Engineering	IWM	6	BE/ B.Tech.(Ag./Civil)

S.No.	Branch/Discipline	Specialization	Code	Seats	Qualifying Degree
5.	Agricultural Engineering	Processing & Food Engineering	PFE	6	BE/ B.Tech. (Ag./Chemical/ Mech./ Electrical)
6.	Mechanical Engineering	CAD/ CAM	ME	8	B.E./ B.Tech. (Mechanical/ Production & Industrial Engg.)
7.	Electrical Engineering	Power Electronics	EE	8	B.E./ B.Tech. (Electrical / Electronics & Communication)
8.	Electronics & Comm. Engineering	Communication Engineering	ECE	8	B.E./ B.Tech. (Electronics & Communication Engg.); Graduateship (AMIETE) examination of IETE
9.	Computer Science & Engineering	Computer Science & Engineering	CSE	8	B.E./ B.Tech. (CSE /CE/IT)
10.	Mining Engineering	Mine Planning	MI	8	B.E./ B.Tech. (Mining)
11.	Civil Engineering	Structural Engineering	CE	8	B.E./ B.Tech.in Civil Engg.
Doctoral (Ph.D.) Programs					
1.	Agricultural Engineering	Farm Machinery & Power Engineering	FMP	4*	ME / M.Tech(Ag. Engg.) in FMP/ REE
2.	Agricultural Engineering	Renewable Energy Engineering	REE	4*	ME / M.Tech (Ag. Engg.) in FMP/REE/PFE; ME /M.Tech in Electrical/Electronics/ Mech./ Chemical/ Civil
3.	Agricultural Engineering	Soil & Water Conservation Engineering	SWC	4*	ME/ M.Tech.(Ag. Engg.) in SWC/ IWM; ME/ M.Tech.in Hydraulics/ Irrigation/ Aquatic/ Aquaculture Engg.
4.	Agricultural Engineering	Irrigation Water Management Engineering	IWM	4	ME/ M.Tech. (Ag. Engg.) in SWC/ IWM; ME / M.Tech. in Hydraulics/ Irrigation
5.	Agricultural Engineering	Processing & Food Engineering	PFE	4*	M.E./ M.Tech. (Ag. Engg.) in PFE
6.	Mechanical Engineering	Mechanical Engineering	ME	4	M.E./ M.Tech. (Mechanical)
7.	Electrical Engineering	Electrical Engineering	EE	3*	M.E./ M.Tech. (Electrical Engg)
8.	Electronics & Communication Engineering	Electronics & Communication Engg.	ECE	4	ME/ M.Tech.(Electronics & Comm. Engg.)
9.	Computer Science & Engineering	Computer Science & Engineering	CSE	4	M.E./ M.Tech.(CSE/ IT)
10.	Mining Engineering	Mining Engineering	MI	4	M.E./ M.Tech. (Mining Engg./ Rock Mechanics / Environmental Engg.)

* Two additional seats are available in each of these specializations from the Academic Session 2017-18 under Quality Improvement Programme for teachers of AICTE approved Degree level Engineering Institutions. The admission procedure shall be as per norms & guidelines of QIP.

Notes:

i) The actual number of admission/seats may be decreased or no admissions may be made in a particular Ph.D./ Masters' program in a particular year depending upon availability of faculty expertise in a particular programme/ discipline.

ii) In M.Tech. programme, there is provision of supernumerary seats as per past practice in each programme for sponsored candidates (as approved by MPUAT/AC-36/2012-02/06).

iii) There is provision of 2 supernumerary seats in each Ph.D. programme across the faculties for in-service candidate's w.e.f. 2012-13 session (as per the academic council's decision i.e. MPUAT/AC-35/2012-01/08).

iv) The candidates seeking admission in M.Tech.(Ag.Engg.) or PhD. (Ag. Engg.) programmes from discipline other than Agricultural Engineering, will be required to take additional pre-requisite courses, as per rules.

v) The candidates seeking admission under Sponsored Category Seats in M.Tech. and Ph.D. shall have to satisfy the following requirements:

   (a) The candidates must have a minimum of two years of full-time work experience in responsible capacity in a Registered Firm/Company/ Industry/Educational and Research Institution/Govt./Quasi Govt./ Autonomous Organisation in the relevant field in which admission is being sought.

   (b) In case of Industry, the Firm/Company/Industry shall either be a public sector undertaking or a public limited company registered in a stock exchange or a private concern whose annual turnover during the past two years exceeds Rs. 5 crores. Further, the Industry sponsored candidates shall be required to fee a higher fee of 1.25 times the normal fees.

   (c) The Educational Institution should be recognized by AICTE/ICAR.

   (d) Letter of appointment and Form – 16 for two years of service is required from the employer at the time of written test / interview. In addition, the candidate must submit an undertaking that he/she will continue to submit Form – 16 for the subsequent years till he/she completes the programme.

   (e) The candidate shall be required submit a suitable undertaking for sponsoring by the sponsoring institution.

vi) The candidates applying as Sponsored candidates shall not be considered for non-sponsored seats. They should submit a separate application with fee, if they want to be considered for normal seats. However, they still have to submit sponsorship certificate and other documents as required for sponsored candidates.

4.0 ADVISORY SYSTEM

4.1 A major advisor shall be assigned to each student admitted in the P.G. programme by the respective departmental committee. A Major advisor can have maximum of 5 candidates under his / her supervision irrespective of M.Tech. / Ph.D. at any point of time. The HOD shall invite application from each PG student in choosing the field of research, indicating preferences of 3 fields in the department. The departmental committee shall consider the preferences of the students on the basis of vacancy and availability of Major advisor on the basis of merit. There is no ban on having major advisor from the outside station considering the problems of research, facilities available at out station in which the major advisor is to be appointed and preference of the student.

4.2 There shall be an advisory committee for each P.G. student constituted by the Director, Resident Instructions (After making such changes as he deems necessary) on the recommendation of the major advisor in consultation with the Head of Department.

4.3 The advisory committee shall consist of minimum 3 accredited teachers from the P.G. faculty which shall consist normally of the major advisor and one advisor from major and minor field each and a nominee of Director, Resident Instructions (from the same or related faculty/fields) in master's programme. The advisory committee of the candidate for Ph.D. degree will consist of minimum 4 accredited members with a major advisor and one member from major field, 2 from minor/supporting fields and 1 DRI nominee. Major advisor will be the Chairman of the committee. The advisory committee should be constituted within one month of 1st Semester.

4.4 If the student's programme of study so requires, he may have an additional major advisor, called co-major advisor. Such co-major advisor would be compulsory if student undertakes post-graduate programme in which MPUAT, Udaipur and some other SAU or institute collaborate.

4.5 Major advisor, Co-major advisor shall be teachers accredited for guiding master's or Ph.D. thesis and members of P.G. faculty.

4.6 Major advisor shall convene the meeting of the advisory committee at least once in each semester to assess the progress of the student and shall maintain a record of it. It should advise the student in such a manner as it deems fit and to ensure that the student can complete the work within the stipulated time.

4.7 The advisory committee will function until the student graduates from that particular programme or is dropped from the rolls of University or College. The DRI nominee must keep a keen eye on the role of advisory committee and would apprise the DRI about the deviations made, if any, from the prescribed procedure. He will also submit a confidential report to DRI.

4.8 The Director, Resident Instructions can replace a member of advisory committee during a programme, if the member including major advisor or co-advisor:-

i) ceases to be member of P.G. faculty.

ii) has requested to be replaced.

iii) is prevented by illness to function properly.

iv) any other valid reasons.

4.8.1 In case of retirement/leaving of chairman next senior person in the discipline in the advisory committee will become chairman of the students' advisory committee and for advisor/member, another member would be recommended by the Head of the Department.

4.8.2 The caretaker HOD/ Dean is permitted to sign the thesis whenever regular HOD/ Dean is out of station or on leave even for a single day after going through the relevant records of the concerned students. Whenever such situation arises, permission be obtained from the competent authority in individual case.

4.8.3 An alternative to major advisor will be provided for conducting viva-voce at a time when major advisor is out of station or he / she is not available for some unavoidable reasons. Whenever such situation arises, permission of HVC should be sought.

4.8.4 The requirement of attending synopsis seminar, pre-thesis seminar and viva-voce on the part of co-major advisor from other institute / organisation is relaxed.

4.9 Function of Advisory Committee:-

4.9.1 The advisory committee shall prepare a programme of study of the student after giving due consideration to his/her academic background and aptitude. He/she may also be required to undertake non-credit courses to overcome any deficiency in his/her academic standard. Successful completion of such non-credit courses would be compulsory.

4.9.2 It shall also discuss the research problem of the student and guide him/her to prepare synopsis and recommend the same through Head, for approval by the Director, Resident Instructions after the student has given a seminar on the subject.

4.9.3 It shall monitor the progress of the student during the programme and advice him/her for maintaining his/her academic standing by suggesting courses to be taken and to plan his/her schedule. For this a meeting of the advisory committee shall be scheduled by major advisor once in each semester and proper record of proceedings be kept.

4.9.4 It shall examine the student for comprehensive or preliminary examination.

4.9.5 It shall approve the standard and quality of the thesis before submission of the thesis to Director, Resident Instructions for external evaluation after the student has presented the work in a seminar.

4.9.6 It shall examine the student in a viva-voce examination on the thesis after due recommendation of the external examiner(s).

4.9.7 No change in the programme of studies shall normally be permitted. However under special circumstance, the Director Resident Instructions on the recommendation of the Advisory Committee, Head of the Department and the Dean of the College concerned with specific reasons to be specified may permit change in the programme of studies.

5.0 ADMISSION TO DEGREE PROGRAMME

5.1 A student admitted to a post-graduate programme shall have to successfully complete the following before award of a degree:

a) An approved programme of study prepared by his/her advisory committee.
b) A comprehensive or preliminary examination.
c) Pre-thesis seminar
d) Submission of thesis and its evaluation.
e) Thesis viva-voce examination.
f) Minimum residential requirement.
g) Minimum OGPA requirement.

5.2 A student for master's programme shall be required to complete a minimum of 57 credit hours for the degree

Title	Approved Load
Major courses (Core & optional)	20-27 Credit Hours (with 12 credit as core)
Minor & Supporting Courses	9-14 Credit Hours
Seminar	1 Credit Hour
Non-Credit Compulsory Courses	2 Credit Hours (as proposed by ICAR)
Total	**37**
Comprehensive	NC
Research	20 Credit Hours

5.3 A student of Ph.D. programme shall be required to complete a minimum of 74 credit hours for the degree. The distribution of courses for Ph.D. would be as under:

Title	Approved Load
Major courses (Core & optional)	18 Credit Hours (with 6 credit as core)
Minor & Supporting Courses	9 Credit Hours
Seminar	2 Credit Hour
Non-Credit Compulsory Courses*	2 Credit Hours (as proposed by ICAR)
Total	**29**
Preliminary	NC
Research	45 Credit Hours

**Exempted for those who have cleared these in Master's programme*

Note:

a) Preliminary will be held but will not be graded / credited towards credit load of the student.

b) Research will be graded as satisfactory.

5.4 The minimum duration of Ph.D. and master's programme shall be 6 and 4 semesters, respectively.

Note: The period for engineering graduates to complete master's programme including remedial courses will be two and half years i.e. 5 semesters.

5.5 A student for master's and Ph.D. programme shall be required to complete a minimum period of 4 semesters and 5 semesters in residence, respectively. However, in case of MOUs with other University, where the research scholar will complete their research work in their parent University, they will be allowed after completion of comprehensive examination. No M.Tech. or Ph.D. student shall be allowed to discontinue the academic programme without completing minimum residential requirement and research work. For PG diploma residence requirement would be at least 2 semesters. However, this shall not debar the University from developing residential instructions in varying proportions for the future P.G. courses.

5.6 A student shall have to complete all the requirements including submission of thesis within 8 and 12 semesters for Master's and Ph.D. programmes, respectively, which will also include period of scholastic probation or temporary withdrawal from the semesters, failing which the admission shall stand cancelled. However, extra semesters with penalty fee will be allowed for 2 semesters in both Master's and Ph.D. programmes.

5.7 A student shall be required to secure a grade point 6.0 out of 10.00 for passing in any course and a minimum OGPA of 6.50 out of 10.00 for the degree.

6.0 REGISTRATION

6.1 A student admitted to a programme shall have to register in the college in the semester admitted within the stipulated time indicated in the notice of admission, failing which his admission will stand cancelled.

6.2 Every post graduate student in good academic standing, unless granted a formal temporary withdrawal by the Dean of College, shall be required to register with the College of his admission in each semester until the completion of all requirements for the degree for which he is admitted.

6.3 A regular student shall be allowed to register upto 18 credit hours but not less than 9 credit hours of courses in any semester. However, in M.Tech. (Ag.) and in the last semester of course work of other programmes he/she may be permitted to register upto 20 credit hours to complete the programme of study.

6.4 The minimum limit of credit hours to be registered in a semester shall not apply to students after completion of minimum residential requirement.

6.5 A Ph.D. student shall be permitted to add courses within 2 weeks or withdraw from courses within 10 weeks of commencement of the semester in such a way that the limits of maximum/ minimum credit hours in that semester have not been crossed.

6.5.1 Attendance in courses joined later shall however, be counted from the date of registration in the semester and it will be the responsibility of the student to maintain minimum attendance requirement.

6.6 Temporary withdrawal from the programme:

6.6.1 A student with good academic standing shall be permitted by the Dean of the College to withdraw from a programme for a specific period not exceeding two semesters on the recommendations of the Major Advisor and Head of the Department, provided he/she makes a written request. Withdrawal in first semester of a programme is not permissible.

6.6.2 The Vice-Chancellor on a written formal application submitted by the student seven days before the expiry of the withdrawal period and duly recommended by the Head of Department and the Dean of College may further grant an extension of withdrawal for one more semester to him/her on the grounds of some compelling situation to be specified.

6.6.3 Failure to register or to obtain formal permission to withdraw from university/ college will constitute presumptive evidence that a student has withdrawn from the college and his/her admission shall stand cancelled.

6.6.3.1 No student shall leave the College/ University without obtaining formal permission from the Dean of the College.

6.6.4 Students granted formal permission of temporary withdrawal may be exempted from all fees during the period of their withdrawal. If he/she withdraws in the middle of a semester, the semester fee will not be refunded. Those who do not obtain formal permission shall be charged full fees for the semesters missed before re-registration.

7.0 AWARD OF GRADES

7.1 Grade point 0 to 10.0 shall be awarded to a student in each course on the basis of marks obtained by him/her in mid-term test and the final semester examination.

For other cases following abbreviations shall be used to denote the performance of a student in a course:

F-	Fail	US-	Unsatisfactory (for thesis & Preliminary / Comprehensive only)
W-	Withdrawn	NC-	Non Credit courses
R-	Repeated	DE-	Detained
S-	Satisfactory (for thesis & Preliminary/ Comprehensive only)	UM-	Unfair means

7.2 Grade DE shall be awarded to a student in a course in which he/she is detained from appearing in the final semester examination on account of shortage in attendance. Grade "DE" will also be equivalent to point "0" (Zero) in 10 point for calculation of "OGPA".

7.3 Grade "W" shall be awarded to a student in a course from which he/she drops from his/her schedule within the time stipulated i.e. 10 weeks from the commencement of semester. Credit hours for this course will not be included for computing OGPA.

7.4 Grade "UM" shall be awarded to a student who has used unfair means in test/final semester examination, and that shall be treated as "0" (Zero) in 10- point scale.

7.5 A student shall be awarded zero in examination/ tests in which he/she fails to appear for any reasons whatsoever. The final grade shall be reported on the basis of marks obtained in other tests/ examinations and the final grade point shall be reported accordingly.

8.0 ACADEMIC STATUS AND SCHOLASTIC PROBATION

8.1 A student shall be required to secure at least a grade point 6.0 in a course for its successful completion.

8.2 A student shall be required to attain a minimum OGPA of 6.5 separately in credit and non-credit courses (deficiency) without F/DE/UM in any course to be on good academic standing.

8.3 A student awarded grade 'F' in a course shall repeat the course to pass it, the grade of repeat course shall replace the earlier one with an `R' associated with it.

8.4 A student with grade 'F' in a course shall be permitted to appear in both the theory and practical examination along with the final semester examination of the consecutive semester. This permission shall be granted for two courses only at a time provided a written request is made within 10 weeks of date of registration in the semester.

8.5 A student with grade 'DE' in courses shall be permitted to repeat it as a regular in the next semester when offered before taking up new courses without affecting the normal schedule of the courses offered in that semester. In case of clash, he/she shall drop the new course (s).

8.6 A student who could not obtain an OGPA of 6.5 at the end of any semester shall be permitted to take a maximum of two courses as back log including the one in which he/she secured GPA of less than 6.5 whenever next offered. The grade of repeated course shall replace the original one with `R' associated with it.

8.7 A student with an OGPA of less than 6.0 at the end of 1st academic year and onwards, he/she will be automatically dropped.

8.8 A student with an OGPA of 6.0 to 6.49 or grades "F", "DE", "UM" in any course at the end of a semester shall be placed on scholastic probation in the subsequent semester. The period of scholastic probation shall be for one semester only.

8.9 A student after being on scholastic probation for three times and dropped from the college, shall be permitted to apply for a mercy petition to the Vice - Chancellor through Dean of the college within 5 days from the date of registration of the next semester. A committee constituted by the Vice – Chancellor, after considering all aspects of the case, shall either recommend the continuation of the student on scholastic probation for one more semester or reject the mercy petition. The committee may review its decision on detection of a patent error or facts.

8.10 A student recommended to continue for one more semester on scholastic probation shall be registered without late fee within seven days of the order and with prescribed fee (revised time to time) for a further period of 3 days or up to last date of registration with late fee whichever is later.

9.0 ATTENDANCE RULES

9.1 A student shall be permitted to appear in the final semester examinations after a minimum attendance of 75% separately for theory and practical in each course from the date of registration in that course.

9.2 Enmasse absence shall be treated as absent in the attendance record of the student.

9.3 A further relaxation of 10% may be granted on the minimum attendance of 75% by the Vice-Chancellor on cogent grounds on the recommendation of the Dean of the College.

9.4 Attendance to the extent of number of lectures/ practicals missed in a course with a maximum of 8 days of absence in a semester shall be credited on production of certificate to the student deputed to represent college and University in co/extra curricular activities of the college/district/state/national level.

10.0 TESTS AND EXAMINATIONS

10.1 There shall be one mid term tests of 20 marks. Courses with theory as well as practical components and courses with theory only shall be examined in written mid term test. Courses with only practicals shall be examined in practicals in the test.

If any student fails to appear in the mid term test on account of hospitalisation (duly supported by hospitalisation certificate from a Govt. Hospital) or for any legitimate reason (including student's deputation for University official programme) duly recommended by course teacher and HoD and approved by the Dean, he/she shall be given the advantage of proportionate marks based on his/her performance in final theory/practical examination as the case may be.

10.1.1 Mid term test shall be held in the mid of the semester and on completion of about 50% of the course.

10.1.2 The duration of Mid semester theory examination (for courses having theory and practical) shall be of one hour. If a course consists entirely of practical, the Mid semester test will be based on practical and will of two hour duration.

10.2 There shall be a final semester examination at the end of a semester consisting of written theory examination of 2 hours duration and practical examination of 3 hours duration or more.

10.3 The distribution of marks in the test and final semester examination shall be:

Mid term test theory/practical		20 Marks
Final Semester Examination		80 Marks
a)	Theory	50
b)	Practical	30

Where there is no practical prescribed, the final theory examination shall be of 80 marks and vice - versa.

10.4 Final semester theory examination shall be conducted by the University.

10.4.1 The external examination for theory portion of PG level core courses shall be conducted by the University. While, the practical will be conducted by a senior faculty member and one more teacher to be nominated by HOD. Where the core paper is totally practical, an external examiner shall be nominated.

10.4.2 The question papers of optional papers shall be set confidentially for each course by the concerned teacher.

10.4.3 The evaluation of answer books of these optional papers shall be done internally by the concerned teachers and grades awarded by them.

10.4.4 Question papers shall contain short and detailed subjective questions as given in the guideline. No choice except internal shall be given.

10.5 Mid term test and practical examination shall be conducted by the office of the Dean of the College on scheduled dates as announced in the academic calendar.

10.6 General Rules:

10.6.1 No tests/examinations shall be postponed on the grounds of failure of electricity supply.

10.6.2 No special test/examination shall be held for students who miss it on grounds like being in police custody or attendance in a court.

10.6.3 Separate rules are prescribed for cases of unfair means and indiscipline in the test/examination.

10.6.4 The coordination committee of the Vice-chancellors has decided that the decision to reconduct the examination in the papers in which students have staged walk out or boycott shall rest with the Chancellor. The students therefore, need not approach the university authority in this regard.

10.6.5 Interested PG students may be shown their answer book(s) within two days of declaration of results for checking totaling and for marking if any answer has been left unmarked.

11.0 SEMINARS

A student in master's programme shall deliver one seminar in 3rd semester.

The course number and number of seminars to be given in Ph.D. programme for 2 credits of seminar allotted should be given as abbreviation of the department followed with 691 & 692 with a credit load of 1 to each seminar course. The students will give 2 seminars under each course. The average/ total marks of 2 seminars will be considered for grade point.

12.0 COMPREHENSIVE EXAMINATION FOR MASTER'S DEGREE

12.1 A student on good academic standing shall be allowed to appear in a comprehensive examination whenever next scheduled after successful completion of at least 75 per cent of course work prescribed.

12.2 The comprehensive examination will consist of two parts; a written examination will be followed by oral examination. The written part will consist of two papers of 100 marks each. The first paper will include questions from major subjects and the second paper will include questions from minor subjects. The papers will be set internally and shall be evaluated internally. The minimum pass marks for written examination shall be 60% in major and minor separately.

12.3 The oral comprehensive examination, in which a student shall be graded as satisfactory / unsatisfactory, shall be conducted by the student's advisory committee under the overall control of the Head of Department.

12.4 If the student's performance is found unsatisfactory, he/she shall re-appear in the comprehensive examination whenever scheduled in the next semester but not earlier than 3 months of first examination.

12.5 No student who has not passed comprehensive examination and all semester examinations, and has not achieved satisfactory grades in each course (Including non-credit deficiency or compulsory courses) shall not be permitted to submit thesis.

13.0 PRELIMINARY EXAMINATION FOR Ph. D. DEGREE

13.1 A student on good academic standing shall be allowed to appear in a preliminary examination, whenever next scheduled after successful completion of 75% course work prescribed.

13.2 The preliminary examination shall consist of two parts, a written examination followed by an oral examination. The written examination shall consist of three papers of 100 marks each. The first two papers will include questions from major subjects and the third paper will include questions from minor subjects. The papers will be set internally and shall be evaluated internally. The minimum pass marks for written examination shall be 60% in each paper separately.

13.3 A student shall appear in oral preliminary examination, if eligible whenever scheduled after the written examination preferably within two months to be conducted by the student's advisory committee and an external examiner and attain a satisfactory performance.

13.4 If a student's performance in oral preliminary examination was unsatisfactory, he shall be required to reappear in oral examination whenever, scheduled next but not earlier than 3 months of previous examination.

13.5 No student shall be permitted to submit thesis unless, he/she achieves satisfactory performance in preliminary examinations.

14.0 SYNOPSIS OF PROPOSED RESEARCH WORK

14.1 A student shall select as far as possible a research topic for his thesis having relevance to the need of the state of Rajasthan.

14.2 The objective of the master's degree research should be to train the student in the research methodology and to develop his/her potential in conducting research,

whereas the Ph.D. degree research should be indicative of the student's capacity for independent constructive thinking and interpretation as well as independent research work. The research work carried-out for Ph.D. degree should be a definite contribution to the advancement in the area and of a quality meriting publication in national and international journals of repute.

14.3 A student shall prepare a synopsis of proposed research work under the guidance of the Major Advisor and the supervision of the advisory committee in the prescribed format and submit the same after giving a seminar in the department where presence of all the members of the advisory committee is must, within the time period prescribed. The synopsis would also have to include in addition to the work plan and justification for taking up the thesis subject, a survey of existing literature on the subject and a list of references.

14.4 The synopsis shall be got examined and shall have to be recommended by the University professor in the subject in MPUAT, Udaipur before final approval by the respective Dean for Master's and by the Director, Resident Instructions for Ph.D. (after making changes, if needed). In the absence of a Professor in the University the Ph.D. research synopsis shall be referred to an outside expert of the rank of University Professor and above for his recommendation about the scope and suitability of the proposed research work. The synopsis of master's degree research shall be recommended by the concerned Head of the Department.

14.5 The synopsis for Master’s and Ph.D. programme should be got approved in II semester.

14.6 The minimum time between synopsis approved and thesis submission shall be two years for Ph.D. and one semester for Master’s programme.

14.7 Once the synopsis has been approved, major changes in the title and/or in the detailed outline shall not be allowed without prior permission of the Director, Resident Instructions. If the major changes are permitted, the student shall submit thesis only after 4 months of approval of the changes. Whereas the minor changes, which do not affect the quantum and quality of work and has been permitted by the Director, Resident Instructions, the time bar shall not be applicable.

14.8 A student shall not start the research work prior to final approval of the synopsis by the Director, Resident Instructions.

14.9 The research work shall normally be carried-out at the campus of student's registration. However, if the departmental committee on the advice of major advisor recommends the conduct of research work at any approved research stations of MPUAT, Udaipur or elsewhere, where facilities for it exist, the student shall be permitted to work there.

15.0 THESIS PREPARATION AND SUBMISSION

15.1 The student's advisory committee shall approve the quantum and quality of research work as per the synopsis approved in a seminar to be given by the student, before he/she starts writing the thesis. The seminar will be open to all the students and faculty members.

15.2 A student shall submit 3 copies of paper bound thesis for master's degree and 5 copies of paper bound thesis for Ph.D. degree along with a soft copy in computer CD together with abstract and required certificates to the Director, Resident Instructions through Major Advisor, Head of Department and Dean of the College.

15.3 The last day for submission of thesis in a semester shall be the last working day, which shall be a day prior to the start of next semester.

15.4 A student shall be permitted to write his thesis in either English or Hindi. A thesis written in English should also carry its title and abstract in Hindi and vice- versa. However for student wanting to submit thesis in Hindi his Major Advisor would have to be satisfied that the particular thesis topic is such that thesis can be written in Hindi and that sufficient literature and Hindi technical words exist regarding the particular topic.

15.5 A student who has successfully completed all requirements including completion of entire research work and presentation of a seminar there on except submission of thesis may be permitted by the Director Resident Instructions to withdraw from the College to resume duties or to accept an employment (this will not be applicable to in-service candidates who have been permitted to carryout research work at the main campus or elsewhere under rule 14.9). He/ She shall, however, have to submit the thesis after completion of all the requirements including comprehensive examination for master's degree and preliminary examination for Ph.D. degree subject to the maximum permissible period prescribed for each degree programmes. He/she shall be required to register in the semester in which thesis has to be submitted

15.6 A student for master's degree may submit thesis within the maximum permissible period after completion of all the requirements. He/she shall be required to register in the semester in which thesis has to be submitted.

15.7 At the time of submission of unbound thesis for evaluation, a student will be required to submit proof and copies of research paper (one from Master's and two from Ph.D. thesis) submitted for publication in a reputed journal.

15.8 The format for thesis laser typing will be as under:

(i) Font size 12 on one and half spacing.

(ii) 1½ inch margin on left and one inch in all other three sides.

(iii) Times New Roman font style.

15.9 It is mandatory for the students to acknowledge Major advisor, members of advisory committee, HOD and Dean by name in the acknowledgement page of thesis as per the proforma outlined in Appendix- XXII .

16.0 COLLABORATIVE PROGRAMME

16.1 A student may be permitted to complete course requirement or research work for his degree in part or full at any ICAR or other institutions having similar programmes provided a MOU to be signed between MPUAT, Udaipur and these institutions on reciprocal basis after approval by the Academic Council on the recommendation of P.G. Faculty. The period spent by the student at these institutions shall be counted towards his/her residential requirement.

16.1.1 A candidate may be sent to any research station of the University or Institute of repute where research facilities and staff are available for conducting research work if in the opinion of the departmental committee the field of candidate's specialization is available away from the campus. The co-major advisor shall be required to be stationed at the place where the candidate carries out research investigation, subject to condition that the scientist is also accredited. The co-major advisor will have to attend synopsis seminar, pre-thesis seminar and thesis viva-voce

examination of the concerned student. The TA and DA for attending these activities will be born from the source of his/her salary.

16.1.2 Internal staff appointed as co-major advisor, advisor and who are posted outside the headquarter on their attending these activities (synopsis seminar, pre-thesis seminary and viva-voce) will draw their TA and DA from the source of their salary. The Officer Incharge should invariable relieve them for these activities.

16.2 A candidate from other SAUs admitted to a Ph.D. degree programme may be permitted to carry out research work for the thesis in his/her home University after completion of all requirements including preliminary examination under an approved and qualified co-advisor of his/her home University on reciprocal basis provided a MOU has been signed.

16.3 When a student is permitted to migrate from any SAUs to MPUAT, Udaipur in the middle of a programme. He shall submit a character certificate, transcript of courses taken and grades obtained in that institution. The Director Resident Instructions shall appoint a committee to examine his/her case and make recommendations about the exemption of credits after a proficiency test, if considered necessary. The exemption of credits permitted by the Director Resident Instructions shall not be greater than 12 credit hours.

16.3.1 The overall grade point average shall be based on the course(s) taken and grades obtained in this University.

16.3.2 The residential requirement for such student shall be determined by the Dean and approved by the Director Resident Instructions in each case separately and shall not be less than two semesters.

17.0 SCHOLARSHIPS PROVIDED BY THE UNIVERSITY

17.1 A student must obtain minimum OGPA of 7.0 out of 10.0 in the first semester at Master's and Ph.D. level. For continuance of scholarship, the candidate is required to maintain OGPA more than 7.0 during Master's and Ph.D. courses. The scholarship shall be discontinued if the student obtains OGPA less than 7.0 but shall be restored on obtaining OGPA more than 7.0 in subsequent examination.

17.2 The SRFs working in Research Schemes may be allowed to pursue their Ph.D. being on fellowship subject to following conditions:

a) The candidate cannot be allowed to complete coursework while being SRF. If he/she is admitted in Ph.D., he/she has to leave the SRF.

b) A Ph.D. scholar can avail SRF only after he/she completes the course work prescribed for Ph.D. However, in such cases the consent of Major Advisor as well as P.I. of the concerned project is mandatory.

18.0 AUTHORITY TO INTERPRET THE RULES

Any question about interpretation of these rules shall be decided by the Vice-chancellor, who may if he so desires consult the Board of Management to seek any necessary clarification.

Note: For any other rules & regulations which have not been covered herein, the students shall refer PROSPECTUS of MPUAT, which is published annually by the University.

APPENDIX **- I**

Format for Accreditation of Teachers for P. G. Teaching & Guiding

Maharana Pratap University of Agriculture & Technology, Udaipur

Application for approval for Post Graduate Teaching and Thesis Guiding

I, hereby apply for the approval of one or more of the following:- (Cross out whichever is not required and if you are already approved for any of the following. Mention order: Notification number and date.)

S.No.	PROGRAMME	CODE	Reference of Approval
1.	Teaching Master's degree programme Only	(R-01)	
2.	Teaching & Guiding Master's degree programme	(R-02)	
3.	Teaching & Guiding Master's degree programme and Teaching Ph.D.'s degree programme.	(R-03)	
4.	Teaching and Guiding Master's and Ph.D. degree programme	(R-04)	

1. Name of the applicant _____
2. Designation _____
3. Department _____
4. Place of present posting _____
5. Present address (Official) _____
6. Academic qualification:

Examination/degree	Year	Board/University	Division & % of marks obtained (OGPA)
Bachelor's ……..			
Master's ……			
Ph.D. …….			
Specify other details (if any)			

7. Titles of thesis submitted for any degree with year of submission:
   _____
   _____
   _____
   _____

8. Experience:

A. Teaching Period No. of Years PG.UG. Class Institution

_____

_____

_____

B. Research/Extension Period No. of Years Institution Remarks

_____

_____

_____

(Attach a list of Research papers published with journals).

9. Number of Students guided:- (a) Master's._____ (b) Ph.D._____

10. Mention below the field of your specialisation and number of years in each:

1. _____
2. _____
3. _____

Dated : _____

Signature of applicant

Recommendation of the Head of Department with justification:

_____

_____

_____

PROF. & HEAD OF THE DEPARTMENT

Remarks of the Dean/Director

_____

_____

_____

DEAN/DIRECTOR

OFFICE OF THE DIRECTOR RESIDENT INSTRUCTIONS

Approved For _____

Code No. _____

DIRECTOR
RESIDENT INSTRUCTIONS
MPUAT, UDAIPUR

APPENDIX – II

----------(**Name of department)**
College of Technology and Engineering
Maharana Pratap University of Agriculture & Technology, Udaipur

No. _____ Dated : _____

PROFORMA FOR THE APPROVAL OF THE ADVISORY COMMITTEE OF PG STUDENTS

Name of the Student : _____
Registration No. : _____
Degree Programme (with subject) : _____
Name of the Major advisor : _____
No. of student under guidance of major advisor (Including present one) : Masters_____ Ph.D_____
Proposed Advisory Committee:

S.No.	Name & Designation	Department	Status	PG Code No.	Signatures
1.					
2.					
3.					
4.					
5.					

Signature of the Major Advisor

No. _____ Date : _____

Forwarded and recommended to the Dean, CTAE.

Professor and Head

No. _____ Date : _____

Forwarded and recommended to the Director, Resident Instructions, Maharana Pratap University of Agriculture & Technology, Udaipur for nominating his nominee and approval of the advisory committee.

DEAN

No. DRI/MPUAT/ Dated: _____

Nominee of Director of Resident Instructions

Name & Designation Department PG Code No.
_____ _____ _____

Proposed Advisory committee is approved

Director, Resident Instructions
MPUAT, Udaipur

APPENDIX - III

College of Technology and Engineering

Maharana Pratap University of Agriculture & Technology, Udaipur

FORMAT FOR APPROVAL OF MASTER'S COURSE PROGRAMME

1. Degree in which admitted ..... Subject ..... Faculty .....
2. Name of the student in full (Block letters) .....
3. Father's Name .....
4. College of admission .....
5. Semester and Year of Admission ..... Category .....
6. Registration: (a) Date ..... (b) Reg.No. ..... (c) Enroll No. .....
7. Permanent address (brief) .....
8. Institution last attended .....
9. Date and place of Birth .....
10. Qualifying degree ..... Aggregate % or OGPA .....
11. Employer's name, if any .....

Above information's are correct.

Signature of student .....

Certified that the academic attainments of the student prior to joining of the aforesaid programme have been assessed properly and the advisory committee recommends the course mentioned in this form including compulsory, deficient, non-credit and or exempted courses

ADVISORY COMMITTEE

S. No	Status	Name & Designation	Deptt.	PG Code No.	Signature
1.	Major Advisor				
2.	Member/ Co Major advisor				
3.	Member				
4.	Member				
5.	Member				

For Courses see on the reverse.

Signature of Clerk

Contd.....

MASTER'S COURSE PROGRAMME APPROVED BY THE ADVISORY COMMITTEE

Course No.	Title of the Course	Credit Hrs.
	MAJOR COURSES **(A) Core (12 Cr. Hrs.)**	
	(B) Optional (8 to 15 Cr. Hrs.)	
	Total	
	MINOR & RELATED COURSES (9 to 14 Cr. Hrs.)	
	Total	
	Non Credit Courses (Minimum 2 Cr. Hrs.) : If exempted, write order No. and date	
	Remedial Courses, if any	
	Seminar..... ..... Comprehensive Non Credit Research.....	01 NC 20
	(Minimum 57 Cr. Hrs. are required) **Grand Total**	

Forwarded & Recommended

Head
(Name & Signature)

Dean
(Name & Signature)

Above course Programme is approved.

Director, Resident Instructions

APPENDIX - IV

College of Technology and Engineering

Maharana Pratap University of Agriculture & Technology, Udaipur

FORMAT FOR APPROVAL OF Ph.D.'S COURSE PROGRAMME

1. Degree in which admitted Ph.D.....Subject.....Faculty.....
2. Name of the Student in full (Block Letters) .....
3. Father's Name .....
4. College of admission .....
5. Semester and Year of Admission .....Category .....
6. Registration : (a) Date. ..... (b) Reg. No. ..... (c) Enroll No. .....
7. Permanent address (brief) .....
8. Institution last attended .....
9. Date and place of Birth .....
10. Qualifying degree ..... Aggregate % or OGPA .....
11. Employer's name, if any .....

Above information's are correct.

Signature of student .....

Certified that the academic attainments of the student prior to joining of the aforesaid programme have been assessed properly and the advisory committee recommends the course mentioned in this form including compulsory, deficient, non-credit and or exempted courses :

ADVISORY COMMITTEE

S.No	Status	Name & Designation	Deptt.	PG Code No.	Signature
1.	Major Advisor				
2.	Member/ Co Major advisor				
3.	Member				
4.	Member				
5.	Member				
6.	Member				

For Courses see on the reverse.

Signature of Clerk

Contd.....

Ph.D. COURSE PROGRAMME APPROVED BY THE ADVISORY COMMITTEE

Course No.	Title of the Course	Credit Hrs.
	MAJOR COURSES **(A) Core (6 Cr. Hrs.)**	
	(B) Optional (Minimum 12 Cr. Hrs.)	
	Total	
	MINOR & RELATED COURSES (Minimum 9 Cr. Hrs.)	
	Total	
	NON CREDIT COURSES (Minimum 2 Cr. Hrs.) : **If exempted, write order No. and date**	
	Seminar .... Preliminary ..... Research	02 NC 45
	(Minimum 74 Cr. Hrs. are required) **Grand Total**	

Forwarded & Recommended

Head
(Name & Signature)

Dean
(Name & Signature)

Above course Programme is approved.

Director, Resident Instructions

APPENDIX - V

Format for submission of Ph.D. Synopsis

Maharana Pratap University of Agriculture & Technology, Udaipur

SYNOPSIS

1. Name of Scholar_____ Class _____
2. Registration No._____ Date of Registration _____
3. Title of Thesis _____
4. Department and College _____
5. Expected duration of the work _____
   (give the period form ..... to .....)
6. Objectives
7. Importance of proposed investigation.
8. Review of Literature.
9. Proposed Plan of work
10. Facilities existing including farm, equipment, laboratories etc. with details.
11. Location of area, if field work
12. Literature cited (Signature of the student at the end of Literature cited with date & place).
13. Certificate in the format given below:

The members of Advisory Committee of Mr./Miss/Mrs..... met on ..... at ..... in which the candidate presented the synopsis of his/her research work entitled ..... to be carried out for Ph.D. degree in ……. in the form of a seminar. After discussion, the committee has recommended the synopsis for approval.

ADVISORY COMMITTEE

S.No.	Name & Designation	Status	P.G. Code No.	Signature
1.		Major Advisor		
2.		Advisor		
3.		Advisor		
4.		Advisor		
5.		DRI Nominee		

We have gone though synopsis critically and fully satisfied with the quantum and quality of proposed research work for Ph.D. (course work) and the same is recommended and forwarded for approval.

Dean
College of Technology and Engineering

Head
Department of .....
College of Technology and Engineering

The synopsis is hereby approved/not approved/to be revised.

Director, Resident Instructions

APPENDIX - VI

Format for submission of Master's Synopsis

Maharana Pratap University of Agriculture & Technology, Udaipur

SYNOPSIS

1. Name of Scholar_____ Class _____
2. Registration No._____ Date of Registration _____
3. Title of Thesis _____
4. Department and College _____
5. Expected duration of the work _____

   (give the period from ..... to .....)
6. Objectives
7. Importance of proposed investigation
8. Review of Literature
9. Proposed Plan of work
10. Facilities existing including farm, equipment, laboratory etc. with details
11. Location of area, if field work
12. Literature cited (Signature of the student at the end of Literature cited with date & place)
13. Certificate in the format given below:

The members of Advisory Committee of Mr./Miss/Mrs..... met on ..... at ..... in which the candidate presented the synopsis of his/her research work entitled ..... to be carried out for Master's degree in ……. in the form of a seminar. After discussion, the committee has recommended the synopsis for approval.

ADVISORY COMMITTEE

S.No.	Name & Designation	Status	P.G. Code No.	Signature
1.		Major Advisor		
2.		Advisor		
3.		Advisor		
4.		DRI Nominee		

I have gone though synopsis critically and fully satisfied with the quantum and quality of proposed research work for Master's degree and the same is recommended and forwarded for approval.

Head
Department of .....
College of Technology and Engineering

The synopsis is hereby approved/not approved/to be revised.

Dean
College of Technology and Engineering

APPENDIX – VII-A

Format of Certificate for submission of report of Comprehensive Examination

CERTIFICATE OF COMPREHENSIVE EXAMINATION FOR MASTER'S PROGRAMME

SEMESTER I/ II, 20_____

This is to certify that Mr./ Miss/ Mrs. _____a student of the College of Technology and Engineering in the subject of _____was examined by the following members of the committee for oral comprehensive examination held on _____at the College of Technology and Engineering. On the basis of his/her performance, the members of the committee have awarded her/him the following marks and grade:

Comprehensive (for Master's degree):

			Marks obtained
a)	Written examination:	Major (MM 100) =	……
		Minor (MM 100) =	……
b)	Oral examination: Satisfactory / Unsatisfactory	(MM 100) =	……

1. Major Advisor
(Name & Signature)

2. Advisor
(Name & Signature)

3. Advisor
(Name & Signature)

4. Advisor
(Name & Signature)

Head of Department
(Name & Signature**)**

No. …….. Date: ……..……

CC: i) The Director, Resident Instructions, Maharana Pratap University of Agriculture & Technology, Udaipur.
ii) The Controller of Examinations, Maharana Pratap University of Agriculture & Technology, Udaipur.
iii) The Dean, College of Technology and Engineering, Udaipur
iv) The Student's file in the department.

HEAD OF DEPARTMENT

APPENDIX – VII-B

Format of Certificate for submission of report of Preliminary Examination

CERTIFICATE OF PRELIMINARY EXAMINATION FOR Ph.D. DEGREE

SEMESTER I/II, 20_____

This is to certify that Mr./ Miss/ Mrs. _____a student of the College of Technology and Engineering in the subject of _____was examined by the following members of the committee for oral preliminary examination held on _____ at the College of Technology and Engineering. On the basis of his/her performance, the members of the committee have awarded her/him the following marks and grade:

Preliminary (for Ph.D. degree):

			Marks obtained
a)	Written examination:	Major I (MM 100) =	……
		Major II (MM 100) =	……
		Minor (MM 100) =	……
b)	Oral examination: Satisfactory / Unsatisfactory	(MM 100) =	……

1. Major Advisor
(Name & Signature)

2. Advisor
(Name & Signature)

3. Advisor
(Name & Signature)

4. Advisor
(Name & Signature)

5. Advisor
(Name & Signature)

External Examiner
(Name & Signature)

Head of Department
(Name & Signature**)**

No. …… Date: ……..

CC: i) The Director, Resident Instructions, Maharana Pratap University of Agriculture & Technology, Udaipur.
ii) The Controller of Examinations, Maharana Pratap University of Agriculture & Technology, Udaipur.
iii) The Dean, College of Technology and Engineering, Udaipur.
iv) The student's file in the department.

HEAD OF DEPARTMENT

APPENDIX- VIII

Format of thesis to be followed

1. Title cover-outer (Covered with plastic sheet)
2. Title cover-inner
3. Title page
4. Certificate - I (Comprehensive/Preliminary Examination)
5. Certificate - II
6. Certificate - III
7. Certificate - IV (Correction Certificate)
8. Acknowledgement
9. Contents
10. List of Tables
11. List of figures and graphs
12. List of appendices
13. Introduction
14. Review of Literature
15. Material and Methods (May be divided into
16. Results suitable chapters
17. Discussion depending upon the
18. Summary problems)
19. Literature cited
20. Abstract in English
21. Abstract in Hindi
22. Appendices

Note :- (i) The size of the thesis should be A4 (8 ½" x 11")

(ii) Thesis should be submitted with computer laser typesetting in 1½ spacing using 12 point size letter.

(iii) The page from Introduction to Literature cited are numbered in Arabic and appendices in Roman (bold face) numbers.

(iv) The bound thesis should have a plastic cover.

(v) The faculty-wise colour-coding of the title cover be as follows:

a)	Agriculture	:	Light Green / Olive Green
b)	**Technology & Engineering**	**:**	**Sky blue / Light blue**
c)	Home Science	:	Light Pink / Pink
d)	Dairy & Food Science Technology	:	Cream
e)	Fisheries	:	Navy Blue
f)	Horticulture & Forestry	:	Golden

APPENDIX - IX

Hint	Format of outer & inner Cover of Master's Thesis
Title in English	**Design Development and Performance Evaluation of Low Cost Hybrid Dryer cum Cooker for Household Usage**
Title in Hindi	**घरेलू उपयोग के लिए कम लागत संकर शुष्कक कुकर की संरचना, विकास और प्रदर्शन मूल्यांकन**
Full Name of Student	*Chaudhary Rameshbhai Harjibhai*
Full Name of Degree (Subject)	**Thesis** **Master of Technology in Agricultural Engineering** **(Renewable Energy Engineering)**
Emblem of the University	
Year	**2016**
Name of the Department & College	**Department of Renewable Energy Engineering** **College of Technology and Engineering** **Maharana Pratap University of Agriculture & Technology, Udaipur**

APPENDIX-X

Format of title page of Master's Thesis

Hint	
Title in English	**Design Development and Performance Evaluation of Low Cost Hybrid Dryer cum Cooker for Household Usage**
Title in Hindi	**घरेलू उपयोग के लिए कम लागत संकर शुष्कक कुकर की संरचना, विकास और प्रदर्शन मूल्यांकन**
Requirement of	**Thesis** **Submitted to the** **Maharana Pratap University of Agriculture & Technology, Udaipur**
Name of Degree in Full (Subject)	**In Partial Fulfillment of the Requirement for the Degree of** **Master of Technolgy in Agricultural Engineering** **(Renewable Energy Engineering)**
Emblem of the University	
Full Name of the Student	By *Chaudhary Rameshbhai Harjibhai*
Year of Submission	2016

APPENDIX - XI

Format of outer & inner Cover of Ph.D. Thesis

Hint	
Title in English	**Studies on Air Assisted Variable Rate Spraying with Ultrasonic Scanning for Orchard Crops**
Title in Hindi	**फलों के बागों हेतु अल्ट्रासोनिक स्कैनिंग युक्त वायु सहायक परिवर्तनीय दर छिड़काव का अध्ययन**
Full Name of Student	Mr. Sachin Vilas Wandkar
Full Name of Degree (Subject)	**Thesis** **Doctor of Philosophy in Agricultural Engineering** **(Renewable Energy Engineering)**
Emblem of the University	
Year of submission	**2016**
Name of the Department & College	**Department of Farm Machinery and Power Engineering** **College of Technology and Engineering** **Maharana Pratap University of Agriculture & Technology, Udaipur**

APPENDIX - XII

Format of title page of Ph.D. Thesis

Hint	
Title in English	**Studies on Air Assisted Variable Rate Spraying with Ultrasonic Scanning for Orchard Crops**
Title in Hindi	**फलों के बागों हेतु अल्ट्रासोनिक स्कैनिंग युक्त वायु सहायक परिवर्तनीय दर छिड़काव का अध्ययन**
Requirement of	**Thesis** **Submitted to the** **Maharana Pratap University of Agriculture & Technology, Udaipur**
Name of Degree in Full (Subject)	**In Partial Fulfillment of the Requirement for the Degree of** **Doctor of Philosophy in Agricultural Engineering** **(Farm Machinery and Power Engineering)**
Monogram of the University	
Full Name of the Student	By Mr. Sachin Vilas Wandkar
Year of Submission	2016

APPENDIX - XIII

Format of Certificate - I to be included in the Thesis

COLLEGE OF TECHNOLOGY AND ENGINEERING
MAHARANA PRATAP UNIVERSITY OF AGRICULTURE & TECHNOLOGY, UDAIPUR

CERTIFICATE - I

Date: _____

This is to certify that _____ student of _____had successfully completed the comprehensive/preliminary examination held on_____ as required under the regulation for Post-Graduate Studies.

(Signature & Date)
Name of the Head of Deptt.
College of Technology and Engineering

Note: While typing include what is applicable only.

APPENDIX - XIV

Format of Certificate - II to be included in the Thesis

COLLEGE OF TECHNOLOGY AND ENGINEERING

MAHARANA PRATAP UNIVERSITY OF AGRICULTURE & TECHNOLOGY, UDAIPUR

CERTIFICATE - II

Date: _____

This is to certify that this thesis entitled _____

_____ submitted for the degree of _____ in the subject of _____embodies bonafide research work carried-out by Mr./Miss/Mrs. _____

(first name) (middle name) (surname)

under my guidance and supervision and that no part of this thesis has been submitted to any other degree. The assistance and help received during the course of investigation have been fully acknowledged. The draft of the thesis was also approved by the advisory committee on _____ .

....

(Head of Department) (Major Advisor)

Name & Signature Name & Signature

.....

(Dean of the College)

Name & Signature

APPENDIX - XV

Format of Certificate - III to be included in the Thesis

COLLEGE OF TECHNOLOGY AND ENGINEERING
MAHARANA PRATAP UNIVERSITY OF AGRICULTURE & TECHNOLOGY, UDAIPUR

CERTIFICATE - III

Date: _____

This is to certify that this thesis entitled _____

_____ submitted by Mr./Miss/Mrs. _____ to Maharana Pratap University of Agriculture & Technology, Udaipur in partial fulfillment of the requirement for the degree of _____ in the subject of _____ after recommendation by the external examiner was defended by the candidate before the following members of the examination committee. The performance of the candidate in the oral examination held on _____ was found satisfactory, we therefore, recommend that the thesis be approved.

.....	.....
(Major Advisor)	(Advisor)
Name & Signature	Name & Signature
.....	.....
(Advisor)	(Advisor)
Name & Signature	Name & Signature
.....	.....
(Advisor)	(Advisor)
Name & Signature	Name & Signature
.....	…….
(Head of the Department)	Dean
Name & Signature	

Approved

DIRECTOR RESIDENT INSTRUCTION
MPUAT, UDAIPUR

APPENDIX - XVI

Format of Certificate - IV to be included in the Thesis

COLLEGE OF TECHNOLOGY AND ENGINEERING
MAHARANA PRATAP UNIVERSITY OF AGRICULTURE & TECHNOLOGY, UDAIPUR

CERTIFICATE - IV

Date: _____

This is to certify that Mr./Miss/Mrs. _____ student of _____(class) _____ (Department) has made all corrections / modifications in the thesis entitled _____ _____ which were suggested by the external examiner and the advisory committee in the oral examination held on _____. The final copies of the thesis duly bound and corrected were submitted on _____.

....

(Head of Department) (Major Advisor)
Name & Signature Name & Signature

APPENDIX - XVII

Format of Certificate for Submission of Viva-Voce Report of Master's thesis

…… (Name of department)

COLLEGE OF TECHNOLOGY AND ENGINEERING

MAHARANA PRATAP UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, UDAIPUR

Date _____

This is to certify that the thesis entitled_____ submitted by Mr./Miss./Mrs./ _____to the Maharana Pratap University of Agriculture & Technology, Udaipur, in partial fulfillment for Masters degree in _____ and recommended by the external examiner was examined orally by the committee consisting of undersigned. The committee recommends that:

*(i) The performance of the candidate has been found satisfactory. We recommend the acceptance of the thesis for the award of degree.

*(ii) The performance of the candidate has been found unsatisfactory. The candidate be asked to re-appear in the oral examination.

.....	.....
(Major Advisor)	(Advisor)
Name & Signature	Name & Signature
.....	.....
(Advisor)	(Advisor)
Name & Signature	Name & Signature
.....	.....
(Advisor)	(Advisor)
Name & Signature	Name & Signature

Forwarded by the Head, Department of _____ to:-

1. The Director Resident Instructions, MPUAT, Udaipur with five copies of bound thesis.
2. The Dean, College of Technology and Engineering, Udaipur.

Head of Department
(Name & Signature)

* Do not include, which is not applicable or strike-out.

** Please note that full name of the Head, Major Advisor and Advisors must be printed.

APPENDIX - XVIII

Format of Certificate for Submission of Ph.D. Thesis Viva-Voce Report

……(Name of Department)

COLLEGE OF TECHNOLOGY AND ENGINEERING

MAHARANA PRATAP UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, UDAIPUR

Date_____

This is to certify that the thesis entitled _____ submitted by Mr./Miss./Mrs. _____ to the Maharana Pratap University of Agriculture & Technology, Udaipur, in partial fulfillment of the Ph.D. degree in _____ (subject) of the faculty of _____ and recommended by both the external examiners was examined orally by the committee consisting of undersigned. The committee recommends that:

*(i) The performance of the candidate has been found satisfactory. We recommend the acceptance of the thesis for the award of degree.

*(ii) The performance of the candidate has been found unsatisfactory. The candidate be asked to re-appear in the oral examination.

.....	.....	.....
(Major Advisor)	Director Resident Instructions/	(Advisor)
Name & Signature	Dean of the College	Name & Signature
.....	.....	.....
(Advisor)	(External Examiner**)**	(Advisor)
Name & Signature	Name & Signature	Name & Signature
.....		.....
(Advisor)		(Advisor)
Name & Signature		Name & Signature

Forwarded by the Head, Department of …….to:-

1. The Director Resident Instructions, MPUAT, Udaipur with five copies of bound thesis and the certificate of incorporation of corrections & suggestions.
2. The Dean, College of Technology and Engineering, Udaipur.

Head of Department
(Name & Signature)

* Do not include, which is not applicable or strike-out.

** Please note that full name of the Head, Major Advisor, Advisors and Dean must be printed.

APPENDIX – XIX

POST GRADUATE SCHEDULE

MASTER'S PROGRAMME

Semester		Activities	Time limits
First	a)	Fresh admission and registration	As scheduled
	b)	Appointment of Major Advisor	15 days
	c)	Formation of Advisory Committee and its approval from Director Resident Instructions	First month
	d)	Meeting of Advisory Committee to chalk course programme	Second month
	e)	Course program approval from Director, Resident Instructions	Third month
Second	a)	Registration in second semester as per the course programme approved by Director, Resident Instructions	As scheduled
	b)	Allotment of research problem	First month
	c)	Seminar on synopsis.	Second month
	d)	Submission of synopsis of the research problem for approval of Director Resident Instructions.	Third month
Third	a)	Request for comprehensive examination	Last month
	b)	Beginning of the research	
Fourth	a)	Beginning of the research	
	b)	Comprehensive examination.	
	c)	Thesis submission.	Last month
Fifth		Thesis submission *	

*Issue of warning to student, if not submitted.

Note: Above time limits are the upper limits by which specified activities must be completed. Efforts be made to adhere with the above prescribed schedule so that all the requirements are timely fulfilled. In case of unusual delay, reason (s) for the same be recorded.

APPENDIX – XX

POST GRADUATE SCHEDULE

Ph.D. PROGRAMME

Semester		Activities	Time limits
First	a)	Appointment of Major Advisor and Advisory Committee	15 days
	b)	Approval of advisory Committee by Director, Resident Instructions	First month
	c)	Meeting of Advisory Committee to chalk-out course programme	Second month
	d)	Course program approval from Director, Resident Instructions	Third month
Second	a)	Registration to second semester as per the course programme approved by DRI	As scheduled
	b)	Allotment of research problem	First month
	c)	Seminar to finalize synopsis of the research work and approval of synopsis by Director, Resident Instructions	Second month
Third	a)	Beginning of the research	First month
	b)	Request for preliminary examination	
	c)	Written preliminary examination	Second month
	d)	Oral preliminary examination	Third month
Fourth		Thesis work	
Sixth		Thesis submission*	

*Issue of warning to student, if not submitted.

Note: Above time limits are the upper limits by which specified activities must be completed. Efforts be made to adhere with the above prescribed schedule so that all the requirements are timely fulfilled. In case of unusual delay, reason (s) for the same be recorded.

APPENDIX - XXI

PROFORMA TO BE USED FOR SIGNING M.O.U. FOR COLLABORATIVE STUDENT'S PROGRAMMES

MEMORANDUM OF UNDERSTANDING

Between …….....……. and MPUAT, Udaipur for carrying out research work at …… ……..……. for Master's and Doctoral Degrees.

1. This memorandum of understanding is executed on …….. (date) between Maharana Pratap University of Agriculture and Technology, Udaipur (hereinafter referred to as the First Party) and …… (hereinafter referred to as the Second Party) for Doctoral and Master's Degrees Research in the field of …….
2. Master's and Doctoral research project will be carried out at the premises of the First Party and the Second Party as per the requirement. The students will complete the project work and prepare the thesis and submit it to the First Party for their respective degrees.
3. There may be periodical meetings of the supervisor at the premises of Second Party or First Party by mutual consultation of both the parties. All the expenditures towards TA/DA of the supervisors to attend such meetings will be borne from the source of the salary.
4. Second party will provide hostel facilities to the students and guest house facilities to the supervisor on payment basis subject to the availability of accommodation in the hostel / guest house.
5. The Second Party would make available the existing facilities like Library, Laboratory, Workshop, fields, etc. to the student for their project works during such timings as are applicable to other institute's employees. There will be no financial liability on the part of First Party (MPUAT) on account of chemicals / glassware or any other expenditure incurred by the second party during the course of Master's/ Doctoral research work.
6. After the thesis is submitted and viva-voce is over, the First Party will provide two copies of the thesis to the Second Party, one for Library and the other for the Co-Major Advisor.
7. The information generated through such project work shall deem to be the credit of both the First Party and the Second Party. In the event of any publication of these results / data, the Co-Major Advisor of Second Party will be one of the authors.
8. The Co-major Advisor will have to attend in person following activities pertaining to Master's/ Doctoral programme of the concerned student for which TA/DA and other expenditure will be charged from the source of his salary:
   a) Synopsis Seminar
   b) Pre-thesis Seminar
   c) Thesis Viva-voce

(Signature of First Party)	(Signature of Second Party)
DEAN	Dean / Associate Dean
DIRECTOR RESIDENT INSTRUCTION, MPUAT, UDAIPUR	Dean (PG) / Director Instruction
REGISTRAR	REGISTRAR

APPENDIX - XXII

ACKNOWLEDGEMENT

I take it to be my proud privilege to avail this opportunity to express my sincere and deep sense of gratitude to my learned major advisor _____ for his stimulating guidance, constructive suggestions, keen and sustained interest and incessant encouragement bestowed during the entire period of investigation, as well as critically going through the manuscript.

I am gratified to record sincere thanks to the members of the advisory committee; Dr. _____ Department of _____,

Dr. _____ Department of _____,

Dr. _____ Department of _____, College of _____ and

Dr. _____, Associate Professor (Department _____) DRI Nominee for their generous gestures and valuable suggestions in planning and execution of this study.

The author is indebted to Dr. _____ Professor & Head, Department of _____, College of _____, Udaipur for providing me facilities and encouragement during the course of investigation.

I am privileged to express sincere and deep sense of gratitude to Dr. _____, Dean, College of _____, Udaipur for his due attention and encouragement during the study period and also for providing me the necessary facilities during the course of research.

Words can hardly register the sincere and heartfelt feeling which I have for Dr. _____, Dr._____, Dr. _____ and other staff members for their kind cooperation and help as and when needed.

I am much obliged to thank _____ in providing me the necessary funds for my post-graduate studies.

I can not forget to thank _____ for his ever willing co-operation and nice laser typesetting of the manuscript.

I feel short of words to express my gratitude to my family members for their utmost co-operation, sacrifice and encouragement during the course of this work.

Place: Udaipur
Date: _____

(Signature & Name of student)

APPENDIX - XXIII

LITERATURE CITED

Variation in **"Literature Cited"** chapter in synopsis / thesis have been observed. In order to maintain uniformity, henceforth following pattern in chapter "Literature Cited" be followed:

Sharma, A.K. and Gautam, B.P. 1999. Integrated pest management strategy against bollworm complex of cotton. *Indian Journal of Entomology* **64** : 623-626.

Rajkhowa, D.J., Kandali, R., Barua, I.C, and Deka, N. C. 2005. Integrated weed and nutrient management practices in wheat + rapeseed intercropping system. *Indian Journal of Weed Science* **37** : 139-141.

Sankaran, S., Jayakumar, R. and Kempuchetty, N. 1993. Herbicide residues. Gandhi Book House, Coimbtore pp. 79-85.

Tiwari, J.P., Kurchania, S.P. and Paradhkar, N.R. 1995. Impact of small canary grass dominated weed eco-system on wheat and effect of isoproturon on sustainable yield. *In* : *Proceedings of Biennial Conference, Indian Society of Weed Science* held at Annamalai during February 9-10,1995, pp. 34-35.

Bellaki, M.A., Badanur, V.P., Faroda, A.S., Joshi, N.L., Kathju, S. and Kar, Amal. 1999. Integrated nutrient management for sustainable crop production. *In: Proceedings of Symposium on Recent Advances in Management of Arid Ecosystem* held at Jodhpur in March,1997. Faroda, A.S., Joshi, N.L. and Kathju, S. (Eds) pp 271-276.

Jat, R.S. 2002. Effect of weed control and method of sowing on productivity of wheat *(Triticum aestivum* L.) in sub-humid southern plain and Aravalli hills zone of Rajasthan. Ph.D. thesis submitted to Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan.

Therefore in concise way following points be taken into consideration:

- Surname of authors be pointed first. Spellings of names of author(s) at two places (text and Literature cited) should correspond
- Year without brackets
- 2nd line from 5th letter of 1st line
- Journal Symposium/ Conference name in full and in italic letters
- Vol. No. should be bold
- Avoid issue number
- Pages 139-141 instead 139-41
- Pages for book ref. as pp. 79-85

APPENDIX - XXIV

DIRECTORATE OF RESIDENT INSTRUCTIONS

Maharana Pratap University of Agriculture and Technology, Udaipur

Rules and Guidelines for award of Gold Medal during University Convocation

Eligibility

1. Each faculty will nominate students double the number of gold medal to be awarded by the respective faculty.
2. Ph.D candidates who have obtained a minimum OGPA of 7.5 or above. The course work should have been completed in semester programme without any ‘‘F’’ grade/ Backlog and any in disciplinary case against him/her.
3. Thesis is compulsory requirement, one extra semester may be allowed for completion and approval of thesis. (Total 7 Semesters).
4. Gold Medal will be given faculty-wise to Ph.D students after competition; minimum number of students for eligibility should not be fixed.

Nomination of names from faculty

1. The names of such selected candidates from each College will be identified by respective Chairman of the faculty through faculty level screening based upon academic achievements, thesis evaluation report submitted by the external examiner and presentation of the research work through seminar by the students in front of the Committee constituted by the Chairman of the faculty.
2. Names of nominated students should be submitted by due date.

Criteria and procedure for final selection of Ph.D. candidates for Gold Medal award

1. For awarding Gold Medal at Ph.D degree level students will be identified through

   University level screening considering following three criteria as under:

   - Academic record
   - Thesis work of the student and Examiners report
   - Presentation of research work

2. The weightage given to these 3 components would be:

	Ph.D.
Academic record	50%-50 marks
Thesis work and report	20%-20 marks
Seminar Presentation	30%-30 marks

3. For award of marks in Academic record, OGPA of the student is to be multiplied by 5. It will form the score of participant's academic record.
4. For award of 20 marks in thesis work, thesis and its evaluation report by external examiner will be given to a committee common for all the faculties. The committee under the chairmanship of DRI shall have 3 Deans nominated by Hon'ble Vice- Chancellor as members. Committee members will individually assign marks out of 20.The marks assigned by the 3 members will be pooled for overall assessment.
5. For remaining 30 marks, students will present a seminar for 10 minutes duration before all the faculty members.
6. The evaluation of students seminar will be done by the Jury approved by Hon'ble Vice-Chancellor comprising of very senior scientist or educationist / technocrats. One of these will act as Chairman of this Jury. The Jury will comprise of 4 members including chairman.
7. The assessment of seminar presentation will be based on following criteria:

			Ph.D.
i.	Language	20 %	6 marks
ii.	Articulation	20 %	6 marks
iii.	Research findings	40%	12 marks
iv.	Conclusion	10%	3 marks
v.	Use of AV aids	10%	3 marks
	Total	100%	30 marks

8. Each member of the jury will assess the performance of the student individually, which will be pooled for overall assessment.
9. In case of tie, the gold medal will be awarded on the basis of academic achievements at UG/ Masters' level and Ph.D. level as the case may be.
10. At stage, warning lights will be arranged where green, yellow and red bulbs will indicate comfortable time, warning time and time up period respectively. Comfortable time will be of 8 minutes. After 8 minutes, yellow light will indicate the warning period and just at the end of 10^{th} minute the red light will signal for time up. A timer bell to indicate the comfortable, warning and time up period will be used in case the lights are not possible. A grace of 15 seconds shall be allowed to finally stop the presentation. After this grace period, negative marking will start; the negative marking will be in the form of deduction of one mark each 15 second slot and the fraction thereof.
11. The evaluation criteria will be explicitly announced in the hall before the start of competition.
12. The cut off for awarding Gold Medal will be as per eligibility criteria i.e. 75 % or more.

APPENDIX - XXV

Dress Code in the University Convocation

क्र.सं.	श्रेणी	ड्रेस कोड
1.	कुलपति एसं कुलसचिव	(i) पुरुष– सफेद/ऑफ व्हाईट/क्रीम कलर का जोधपुरी सूट, मेवाड़ी पगड़ी एवं काले जूते (ii) महिला– सफेद/ऑफ व्हाईट क्रीम कलर की साड़ी मय लाल कलर का बॉर्डर व ब्लाऊज एवं काले सेंडिल/स्लीपर इस श्रेणी हेतु लाल कलर का स्टॉल्स (मय चमकीला बॉर्डर) एवं बैज उपयोग करेंगे।
2.	विश्वविद्यालय के अधिकारी/प्राधिकारी	(i) पुरुष– सफेद/ऑफ व्हाईट/क्रीम कलर का जोधपुरी सूट, मेवाड़ी पगड़ी एवं काले जूते (ii) महिला– सफेद/ऑफ व्हाईट क्रीम कलर की साड़ी मय लाल कलर का बॉर्डर व ब्लाऊज एवं काले सेंडिल/स्लीपर इस श्रेणी हेतु लाल कलर का स्टॉल्स (मय चमकीला बॉर्डर) एवं बैज उपयोग करेंगे।
3.	बिन्दु संख्या 2 के अतिरिक्त अन्य प्राधिकारी यथा जन प्रतिनिधि, विभिन्न नामित व्यक्ति (Non-officials)	(i) पुरुष– सफेद/ऑफ व्हाईट/क्रीम कलर का जोधपुरी सूट, मेवाड़ी पगड़ी एवं काले जूते (ii) महिला– सफेद/ऑफ व्हाईट क्रीम कलर की साड़ी मय लाल कलर का बॉर्डर व ब्लाऊज एवं काले सेंडिल/स्लीपर इस श्रेणी हेतु लाल कलर का स्टॉल्स (मय चमकीला बॉर्डर) एवं बैज उपयोग करेंगे।
4.	डिग्री / मैडल प्राप्त करने वाले विद्यार्थी	(i) पुरुष– सफेद कलर का कुर्ता–पायजामा/पेंट–शर्ट/धोती–कुर्ता तथा काले जूते (ii) महिला– सफेद साड़ी/सलवार–सूट लाल कलर का बॉर्डर व ब्लाऊज एवं चुन्नी/दुपट्टा एवं काले सेंडिल/स्लीपर इस श्रेणी हेतु लाल कलर का स्टॉल्स (मय चमकीला बॉर्डर) एवं बैज उपयोग करेंगे।

नोटः सर्दियों के मौसम में गहरे मैरून रंग का जैकट उपयोग में लिया जाये।

APPENDIX - XXVI

College of Technology and Engineering

Maharana Pratap University of Agriculture & Technology, Udaipur

Guidelines/ Summary of PG Rules to be followed by the PG students during their course of studies (indicative only, subject to change)

Semester	Particulars	M. Tech.	Ph.D	Remarks
	Core Courses	4	2	Resolution No. MPUAT/AC/24/2008-01/07
I	Admission & Registration	As per schedule	As per schedule	
	Appointment of Major Advisor	15 days	15 days	
	Advisory committee formation & it's approval	1st month	1st month	
	Meeting of advisory committee to chalk out course programme	2nd month	2nd month	
	Course programme approval from DRI	3rd month	3rd month	
II	Registration	As per schedule	As per schedule	
	Allotment of research problem	1st month	1st month	
	Seminar to finalize synopsis of the research work	2nd month	2nd month	
	Submission of Synopsis & it's approval	3rd month	2nd month	For M.Tech. submit five copies, approval by DRI. For Ph.D. initially send only one copy to the DRI (only when there is no professor in the department)
III	Beginning of the research	√	1st month	
	Request for comprehensive examination	Last month	-	To Dean for written and oral
	Request for preliminary examination	-	1st month	To Dean for written and to DRI for oral for appointment of external examiner (thro' the Dean).
	Written preliminary examination	-	2nd month	Resolution No. MPUAT/AC/24/2008-01/14
	Oral preliminary examination	-	3rd month	By the external examiner appointed by DRI

IV	Research	Continued	-	
	Comprehensive examination	1st month	-	By the advisory committee
	Written preliminary examination	-	2nd month	
	Thesis submission	Last month	-	
	Oral examination	Through LCD presentation in front of the advisory committee	-	After evaluation & receipt of thesis from the external examiner
	Final bound thesis submission	After oral examination	-	Incorporating necessary corrections. Also submit 2 sets of requisite certificates
V	Thesis, if not submitted	*	-	
IV-VI	Research / Thesis work	-	Continued	
VI	Thesis submission	-	*	
	Ph.D. thesis viva-voce	-	Through LCD presentation in front of the external examiner & advisory committee	After evaluation & receipt of the thesis from the external examiners
	Final bound thesis submission	-	After Ph.D. thesis viva-voce	Incorporating necessary corrections. Also submit 2 sets of requisite certificates

*Issue of warning to student, if not submitted.

Note:

1. Above time limits are the upper limits by which specified activities must be completed. Efforts be made to adhere prescribed schedule so that all the requirements are timely fulfilled. In case of unusual delay, reason(s) for the same be recorded.
2. Guidelines for conduct of M.Tech./Ph.D. thesis viva-voce you may refer DRI letter No.F/DRI/MPUAT/2008/1046-85 Dt.04.04.08.
3. For PDC/Result, submit 2 sets of requisite certificates (along with letter of approval from DRI) to the Dean, CTAE.

IMPORTANT

Any dispute arising out of anything connected with the University/ College and its activities including admission/ operation of semester rules will be subject to the jurisdiction of the courts situated in Udaipur.

DISCLAIMER

The statement made in the “Post Graduate Studies Regulations and Course Description” and all information contained herein is believed to be correct at the time of publication. However the university, the DRI and the college reserves the right to make any change and/or addition to the regulations, conditions governing the conduct of students, requirement for degree, fee and any other information, or statements contained in this at any time without notice. No responsibility will be accepted by the university or the College for any hardship or expenses incurred by its students or any other person or persons for such changes, additions, omissions or errors, no matter how they are caused.

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COURSE DESCRIPTION

(SECTION- II)

M. Tech. and Ph.D.

CIVIL ENGINEERING
COMPUTER SCIENCE ENGINEERING
ELECTRICAL ENGINEERING
ELECTRONICS & COMMUNICATION ENGINEERING
MECHANICAL ENGINEERING
MINING ENGINEERING

Effective from 2016-17

COLLEGE OF TECHNOLOGY AND ENGINEERING
MAHARANA PRATAP UNIVERSITY OF AGRICULTURE & TECHNOLOGY
UDAIPUR (Rajasthan) 313001

CONTENTS

DEPARTMENT OF CIVIL ENGINEERING

VISION

The Department of Civil Engineering was established with a vision of creating a technical education centre of high standards and conducting research at the cutting edge of technology to meet the current and future challenges of technological development.

MISSION

- To offer high quality graduate and post graduate programs in Civil Engineering.
- To generate Competent Professionals to become part of the society/ Industry and Research Organizations at various levels.
- To provide necessary guidance and motivation to enable the Students to become Entrepreneurs.
- To promote Research and Development in the emerging and sustainable areas of Civil Engineering.
- To contribute our present skills to provide technical services to society/Industry and to increase interaction with various engineering organizations.

Programme Educational Objectives

1. To provide proficiency in advance courses relating to structural engineering. A graduate must be able to view construction practices as an integrated continuum of technologies and to engage in integrated system level design.
2. To develop the analytical and logical aptitude among students to assimilate new information, and solve new problems for sustainable development relating to the field of structural engineering.
3. To provide exposure of new cutting edge technologies to the students and to motivate them to take up new challenges to solve the problems faced by society and nation through research and development related to the field construction.

4. To inculcate the nature of self learning, discipline and leadership qualities in students and to introduce them to holistic approach of working in a team according to the codes of professional practice.

Program Outcome

1. Graduates will demonstrate an ability to apply knowledge of Structural engineering, advanced mathematics, management and logical analysis of problems and solution as it applies to the field of Structural Engineering.
2. Graduates will demonstrate the ability to function as a member of engineering and social laboratory teams, as well as on multidisciplinary design teams.
3. Graduates will demonstrate the ability to learn and work independently to identify and solve structural engineering related new problems.
4. Graduates will demonstrate an understanding of their professional and ethical responsibilities.
5. Graduates will possess effective communicational skills both orally and in writing.
6. Graduates will have the confidence and potential to apply engineering solutions in global and social contexts.
7. Graduates will be disciplined and will show the capabilities of independent problem solving, self learning and innovation.

Semester-wise Scheme for Post Graduate Programme in Civil Engineering

Details of courses offered for the award of M.Tech. (Structural Engineering)

S. No.	Title	Course No.	Cr. Hr.	Semester			
				I	II	III	IV
Core Courses: Total 16 credits, two courses in first and two courses in second semester each (8 credit in each semester) to be evaluated externally.							
1	Advanced Structural Analysis	CST 511	4 (3+1)	4	-	-	-
2	Advanced Concrete Structures	CST 512	4 (3+1)	4	-	-	-
3	Advanced Steel Structure	CST 521	4 (3+1)	-	4	-	-
4	Advanced Concrete Technology	CST 522	4 (3+1)	-	4	-	-
Optional (Major) Courses: Total 12 credits; Two courses in first and two in second semester each (6 credits in each semester).							
1	Structural Dynamics	CST 513	3 (3+0)	3	-	-	-
2	Ground Improvement Techniques	CST 514	3 (3+0)	3	-	-	-
3	Earth Retaining Structures	CST 515	3 (3+0)	3	-	-	-
4	Pre-stress Structures	CST 516	3 (3+0)	3	-	-	-
5	Methods of Numerical Analysis	BS 521	3 (3+0)	-	3	-	-
6	Advance Metal Structure	CST 523	3 (3+0)	-	3	-	-
7	Quality and Safety Management	CST 524	3 (3+0)	-	3	-	-
8	Composite Structure	CST 525	3 (3+0)	-	3	-	-
Minor & Supporting Courses: Total 12 credit, one course in first semester, one course in second semester and two courses in third semester (12 credits in third semester).							
1	Maintenance & Rehabilitation of Constructed Facilities	CST 517	3 (3+0)	3	-	-	-
2	Advanced Solid Mechanics	CST 518	3 (3+0)	3	-	-	-
3	Advanced Foundation Design	CST 526	3 (3+0)	-	3	-	-
4	Tall Buildings	CST 527	3 (3+0)	-	3	-	-
5	Finite Element Methods	CST 531	3 (3+0)	-	-	3	-
6	Bridge Engineering	CST 532	3 (3+0)	-	-	3	-
7	Earthquake Resistant Structure	CST 533	3 (3+0)	-	-	3	-
8	Disaster Reduction & Management	CST 534	3 (3+0)	-	-	3	-
Others							
	Compulsory Courses; {(0+1) or (1+0)} Non Credit (NC); PGS Series	PGS 501/ PGS 502…	1	NC	NC	-	-
	Seminar	CST 535	5 (0+5)	-	-	5	-
	Comprehensive	CST 536	NC			NC	
	Research (Thesis). Thesis minimum duration 2 semesters	CST 541	20(0+20)	-	-	-	20
	Total credits to be offered (for Master Programme)		**65**	**17**	**17**	**11**	**20**

COURSE SUMMARY

Courses	No. of Courses					Credit Hours
	Semester					
	I	II	III	IV	Total	
Core	2	2	-	-	4	16
Optional (Major)	2	2	-	-	4	12
Minor & Supporting	1	1	2	-	4	12
Seminar	-	-	1	-	1	5
Comprehensive		-	-	1	1	Non Credit (graded as satisfactory/ non satisfactory)
Research (Thesis)	-	-	-	1	1	20* (graded as satisfactory/ non satisfactory)
Compulsory Courses (PGS Series)	1	1	-	-	2	Non Credit
Total	**6**	**6**	**3**	**2**	**17**	**65**

*Research (Thesis) credit load is not counted in calculation of final OGPA.

SYLLABUS

CIVIL ENGINEERING

(Specialization in Structural Engineering)

CST 511 Advanced Structural Analysis

	L	T	P
Credit	3	0	1
Hours	3	0	2

Course Outcome	Upon completion of this course the students will be familiar with:
CO1	Matrix methods in skeletal structural analysis
CO2	Development of stiffness matrix
CO3	Analysis of continuous beams by stiffness method
CO4	Solution of general type of structures by use of transformation matrix

Matrix methods in skeletal structural analysis: force and displacement methods; Static and kinematic indeterminacy for plane and three dimensional structures; Direct stiffness method; Formation of member stiffness matrix; Transformation of load vector and displacement vector; Formation of global stiffness matrix; Evaluation of elements of stiffness matrix; Analysis of continuous beams, plane frames, plane trusses; Automatic formulation of logical steps enabling compute solution by stiffness method.

Reference Books

1. Martin H.C. – Introduction to Matrix Methods in Structural Analysis – McGraw Hill.
2. Ghali & Neville – Structural Analysis – A unified classical & Matrix Approach – SPON Press London.
3. Pandit and Gupta – Structural Analysis – A Matrix Approach – TMH Publications.
4. Gere & Weaver – Matrix Analysis of framed structures – CBS Publications, Delhi.
5. T.N. Ganju – Matrix Structural Analysis using spreadsheets – TMH Publication.

CST 512 Advanced Concrete Structures

	L	T	P
Credit	3	0	1
Hours	3	0	2

Course Outcome	Upon completion of this course the students will be familiar with:
CO1	Analysis of slabs by yield line theory
CO2	Analysis and design of grid floors
CO3	Redistribution of moments for continuous beams and frames
CO4	Analysis and design of silos bunkers and chimney

Yield Line Theory for analysis of Slabs: Equilibrium and virtual work methods of analysis, Rectangular slabs with various edge conditions – yield line patterns, Circular slabs, Design for limit state of strength and serviceability.

Grid or Coffered Floors: General features, Rigorous and approximate methods of analysis, Design of grid floors.

Moment-curvature relationship for reinforced concrete sections.

Redistribution of moments in multi-span beams and frames.

Silos and bunkers: Jensen and Airy's theories, circular, square and rectangular bins.

Chimneys: Wind and temperature effects.

Reference Books

1. P.C. Varghese – Advanced Reinforced Concrete Design, Prentice Hall of India Pvt. Ltd., New Delhi.
2. Pillai and Menon, 'Reinforced Concrete Design ', Tata McGraw Hill, New Delhi.
3. Jain A.K., 'Reinforced Concrete-Limit State Design', Nem Chand & Bros. Roorkee.
4. B.C. Punmia, Ashok K. Jain, Arun K. Jain – Reinforced Concrete Structures Vol. II, Laxmi Publications, New Delhi.
5. N.C. Sinha, S.K. Roy – Fundamentals of Reinforced Concrete, S. Chand & Co. Ltd, New Delhi.
6. IS: 456: Indian Standard code of practice for plain and reinforced concrete, Bureau of Indian Standards, New Delhi.

CST 521 Advanced Steel Structure

	L	T	P
Credit	3	0	1
Hours	3	0	2

Course Outcome	Upon completion of this course the students will be familiar with:
CO1	Elasto-plasto behavior of structural steel sections
CO2	Analysis of structures by plastic theory
CO3	Design of beams subjected to high shear
CO4	Use of limit state of strength and serviceability to design the rectangular and gable portal frames

Plasticity in ductile materials, actual and idealized stress-strain graph for mild steel, elasto-plastic behavior of beam in flexure, shape factor for different cross sections, yield zones, concept of plastic hinge.

Plastic collapse loads of determinate and indeterminate structures such as beams and rectangular portal frames, static and kinematic methods, basic and combined mechanisms.

Limit State of Strength and Serviceability for advanced steel structure, design of laterally unsupported beams, shear resistance Secondary design considerations, design of beams with high shear, interaction of bending and shear, interaction of bending and axial force.

Design of rectangular and gable portal frames.

Reference Books

1. Handbook for Structural Engineers SP 6 (8) 1972 (Reaffirmed 1995) – Bureau of Indian Standards.
2. SP: 6 (6) – 1972 Handbook for Structural Engineers: Application of plastic Theory in Design of Steel Structures.
3. IS: 800:2007 Code of Practice for General Construction in Steel.
4. A.S. Arya and J.L. Ajmani – Design of Steel Structures, Nemichand & Bros., Roorkee.
5. Teaching Resource for Structural Steel Design – INSDAG Kolkatta.
6. Ramchandra – Design of Steel Structures Vol – II, Standard Book House, Delhi.
7. B.G. Neal – Plastic Method of Structural Analysis, Chapman & Hall.
8. L.S. Beedle – Plastic Design of Steel Frames, John Willey & Sons.

CST 522 Advanced Concrete Technology

	L	T	P
Credit	3	0	1
Hours	3	0	2

Course Outcome	Upon completion of this course the students will be familiar with:
CO1	Factors for variability of concrete strength and concept of concrete mix design
CO2	Microstructure of concrete, deterioration mechanism and corrosion control
CO3	Manufacturing and application of various types of concrete
CO4	Special concreting methods

Variability of concrete strength, Principles of concrete mix design, Methods of concrete mix design, Advanced testing of concrete.

Microstructure of concrete, deterioration mechanisms, assessment and control of corrosion in concrete structures.

Light weight concrete, Fly ash concrete, Polymer Concrete, Super plasticized concrete, Epoxy resins and screeds for rehabilitation - Properties and Applications - High performance concrete.

Fibre reinforced concrete, fibres materials, mix contents, distribution and orientation, interfacial bond Process of manufacturing of concrete, methods of transportation, placing and curing.

Extreme weather concreting, special concreting methods, Vacuum dewatering - underwater concrete.

Reference Books

1. Neville, A.M., Properties of Concrete, Pitman Publishing Limited, London.
2. Mehta PK & Monteriro P.J.M., "Concrete Microstructure, Properties and Materials".
3. Shetty M.S., Concrete Technology, S. Chand and Company Ltd. Delhi.
4. Rudhani G., Light Weight Concrete Academic Kiado, Publishing Home of Hungarian Academy of Sciences, 1963.

CST 513 Structural Dynamics

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome	Upon completion of this course the students will be familiar with:
CO1	Behavior of structures under dynamic loading
CO2	Undamped and damped free vibration for single degree of freedom systems
CO3	Forced vibration response of Single degree of freedom systems, Seismic instruments
CO4	Concept of vibrations of multi degrees of freedom systems

Dynamics of Structures: Objective and importance, Types of dynamic loads, Dynamic degree of freedom, mathematical modeling, damping and stiffness, Equivalent stiffness, Free and forced vibrations.

Single Degree of Freedom (SDOF) Systems: Undamped free vibrations, formulation of differential equation of motion: Newton's law of motion, D'Alembert's principle and energy approach, Natural frequency, Vibration response.

Single Degree of Freedom (SDOF) Systems: damped free vibrations, critically damped, under damped and over damped systems, formulation of differential equation of motion: Natural frequency. Vibration response.

Forced vibration response of SDOF damped and undamped systems to harmonic loading, Vibration isolation and transmissibility. Seismic Instruments.

Vibrations of two degree of freedom systems, matrix formulation of equations of motion, principal modes of vibrations. Extension of the concept to MDOF systems.

Reference Books

1. Mario Paz – Structural Dynamics Theory and Computation, CBS Publications.
2. Anil K Chopra – Dynamics of Structures Theory and Applications to Earthquake Engineering, Prentice-Hall Publications.
3. R.W Clough and J Penzin – Dynamics of Structures, McGraw Hill Publications.
4. Madhujit Mukhopadhyay–Structural Dynamics Vibrations and Systems, Ane Books India Publishers.

CST 514 Ground Improvement Techniques

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome	Upon completion of this course the students will be familiar with:
CO1	Role and importance of ground improvement techniques
CO2	Various methods of ground improvement techniques
CO3	Concept of reinforcement in soils and Mechanism of soil interaction
CO4	Case studies on ground improvement techniques

Introduction: Engineering properties of soft, weak and compressible deposits, Natural land, off-shore and Man-made deposits. Role of ground improvement in foundation engineering, methods of ground improvement, Selection of suitable ground improvement techniques; In-situ treatments methods: In-situ densification soils, Dynamic compaction and consolidation, Sand pile compaction, Preloading with sand drains and fabric drains, Granular columns, Micro piles, Soil nailing, Ground Anchors, Lime piles, Injections, Thermal, Electrical and Chemical methods, Electro osmosis, Soil freezing.

Reinforced Soil: Mechanism, Reinforcement materials, Reinforcement-Soil Interactions, Geosynthetics, Embankments and Slopes; Ground Improvement Techniques for Geotechnical Earthquake Engineering, Case studies on ground improvement techniques.

Reference Books

1. R. M. Korner, *Design with Geosynthetics*, Prentice Hall, New Jersy, 3rd Edn. 2002.
2. P. Purushothama Raj, *Ground Improvement Techniques*, Tata McGrawHill, New Delhi, 1995.
3. B. M. Das, *Principles of Foundation Engineering,* Thomson, Indian Edition, 2003.
4. G. V. Rao and G. V. S. Rao, *Text Book on Engineering with Geotextiles*, Tata McGraw Hill.
5. T. S. Ingold and K. S. Miller, *Geotextile Hand Book*, Thomas Telfrod, London.
6. N. V. Nayak, *Foundation Design Manual*, Dhanpat Rai and Sons, Delhi.

CST 515 Earth Retaining Structures

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome	Upon completion of this course the students will be familiar with:
CO1	Earth pressure theories
CO2	Concept and application of bulkheads
CO3	Sheet Pile wall
CO4	Stress distribution around tunnels

Earth Pressure: Fundamental relationships between the lateral pressures and the strain with a back fill. Rankine and Coulomb theories, Active, passive and pressure at rest ; Backfill with broken surface, wall with broken back, concentrated surcharge above the back fill, earth pressure due to uniform surcharge, earth pressure of stratified backfills, saturated and partially saturated backfill. Passive earth pressure in engineering practice. Assumption and conditions, point of application of passive earth pressures ; Bulkheads: Definition and assumptions, conditions of end supports and distribution of active earth pressure and bulkheads, Anchorage of bulkheads and resistance of anchor walls, spacing between bulkheads and anchor walls, resistance of anchor plates, Consideration of effects of ground water, seepage, surcharge loading together with possibility of shallow and deep sliding failures on retaining structure; Sheet Pile wall: Free earth system, fixed earth system, Dead man; Tunnel and Conduit: Stress distribution around tunnels, Types of conduits; Arching and Open Cuts: Arching in soils, Braced excavations.

Reference Books

1. B. M. Das, *Principles of Foundation Engineering,* Thomson, Indian Edition, 2003.
2. J. Bowel, *Foundation Engineering*, Analysis and Design. McGrwHill.
3. P. Raj, *Geotechnical Engineering*, Tata McGraw Hill.
4. R F Craig, *Soil Mechanics,* Chapman and Hall (ELBS).

CST 516 Pre-Stress Structures

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome	Upon completion of this course the students will be familiar with:
CO1	Analysis and design of partially pre-stressed structures
CO2	Shear design of pre-stressed concrete members
CO3	Analysis and Design of continuous beams
CO4	Design of end anchorage zones

Partial prestressing, non-prestressed reinforcements, Design of partially Prestressed concrete members.

Shear resistance of prestressed concrete members: Principal stresses and ultimate shear Resistance, Design of shear reinforcement, prestressed concrete, members in Torsion, Design of reinforcement in torsion shear and bending.

Statically Indeterminate Structures: Primary and secondary moments, Continuity, concordant cable profile, Choice of cable profile-linear transformation-concordancy. Analysis and Design of continuous beams. Composite Beams: Composite sections of Prestressed concrete beam and cast in-situ RC slab; Analysis of stress, Design of composite sections.

Stress distribution in end block, Analysis and Anchorage Zone reinforcement, Design of end anchorage zones using IS code method.

Prestressed concrete poles.

Prestressed Concrete tanks: General features, Analysis and design of circular tanks.

Reference Books

1. T.Y. Lin & Ned H. Burns – Design of Prestressed Concrete Structures, John Wiley Publication.
2. N. Krishna Raju – Prestressed Concrete, Tata Mc Graw Hill Publication Co.
3. Edward Nawy – Prestressed Concrete – A Fundamental Approach, Prectice Hall International.
4. P.C. Varghese – Advanced Reinforced Concrete Design, Prentice Hall of India Pvt. Ltd., New Delhi.

5. IS: 456: Indian Standard code of practice for plain and reinforced concrete, Bureau of Indian Standards, New Delhi.
6. IS: 1343: Indian Standard code of practice for Prestressed concrete, Bureau of Indian Standards, New Delhi.
7. IS: 1893: Indian Standard Code of practice for criteria for Earthquake resistant design of structures, Bureau of Indian Standards, New Delhi.
8. IS: 3370-Indian Standard code of practice for concrete structures for storage of liquids, Bureau of Indian Standards, New Delhi.

BS521 Methods of Numerical Analysis

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome	Upon completion of this course the students will be familiar with:
CO1	Solution of system of linear equations
CO2	Numerical solution of ordinary differential equations
CO3	Solution of algebric and transcendental equations, Interpolation
CO4	Solution of difference equations

Solution of system of linear equations: Gaussian elimination method, Gauss-Jordan method, Gauss-Seidel method, matrix inversion method. Matrix Eigenvalue problem: Power method and inverse power method.

Numerical solution Ordinary Differential Equations: Taylor's series method, Picard's method, Euler's and Euler's modified method, Runge-Kutta methods.

Solution of Algebraic and Transcendental Equations: Bisection method, False position method, Newton Raphson method.

Interpolation: Forward, backward and central difference operators, Shifting and Averaging operator, relation between difference operators. Forward and backward interpolation formulae, Lagrange's interpolation formula for unequal intervals.

Solution of difference equations: Linear difference equations, different forms of particular solutions.

Reference Books

1. Babu Ram, Numerical Methods, Pearson Education India.
2. Santosh K. Gupta, Numerical Methods for Engineers, New Age International Publishes, New Delhi.
3. Dileep S. Chouha, Paresh Vyas & Vimlesh Soni, Studies in Numerical Analysis, Jaipur Publishing House, Jaipur.
4. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering computation, New Age International (P) Ltd, New Delhi.

CST 523 Advanced Metal Structures

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome	Upon completion of this course the students will be familiar with:
CO1	Analysis & design of hoarding structures and castellated beams
CO2	Design of aluminium structures
CO3	Codal provisions for design of microwave and transmission towers
CO4	Codal provisions Cold Form light gauge section

Hoarding Structures – Analysis and design of hoarding structures under dead live and wind load conditions.

Castellated beams – Fabrication of the castellated beam from rolled beam. Design of castellated beam for bending and shear

Design of Aluminum Structures: Introduction, Stress-Strain Relationship, Permissible Stresses, Tension and Compression Members, Laced and Battened Columns, Beams, Riveted and Bolted Connections.

Microwave Towers – Introduction, structural configuration, function. Transmission Towers – Introduction, structural configuration, bracing systems, codal provision for design of tower and foundation.

Codal provisions Cold Form light gauge section- Type of cross section, Stiffened, multiple stiffened and unstiffened element, flat- width ratio, effective design width, Design of light gauge compression, tension members.

Reference Books

1. Ram Chandra - Design of steel Structures Vol II, Standard Book House, Delhi.
2. Teaching resource materials by INSDAG, Kolkatta.
3. IS: 800: Code of Practice for General Construction in Steel 22/29.
4. IS: 875: Code of Practice for Structural Safety of Building: Loading Standards (Revised).
5. IS: 801: Code of practice for use of cold formed light gauge steel structural members in general building construction.
6. IS: 802:Code of practice for use of structural steel in overhead transmission line towers.
7. IS : 806: Code of practice for use of steel tubes in general building construction.
8. IS : 4014:(part I and II) Code of practice for steel tubular scaffolding.
9. SP: 6 (5): Structural use of light gauge steel.
10. IS codes for Aluminum Structures, IS:3908, 3909, 3921, 5384, 6445, 6476, 6475, 6449, 8147, Bureau of Indian Standards.

CST 524 Quality and safety Management

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome	Upon completion of this course the students will be familiar with:
CO1	Quality control mechanisms
CO2	Quality assurance systems
CO3	Concept of safety and factors affecting safety; provisional aspect of safety
CO4	Accident management

Introduction to quality: Planning and control of quality during design of structures. Quantitative techniques in quality control. Quality assurance during construction. Inspection of materials and machinery. In process inspection and test. Preparation of quality manuals, check-list and inspection report.

Establishing quality assurance system: Quality standards/codes in design and construction. Concept and philosophy of total quality management (TQM). Training in quality and quality management systems (ISO-9000).

Concept of safety & Factors affecting safety: Physiological, Psychological and Technological. Planning for safety provisions. Structural safety. Safety consideration during construction, demolition and during use of equipment.

Provisional aspect of safety: Site management with regard to safety recommendations. Training for safety awareness and implementation. Formulation of safety manuals. Safety legislation, standards/codes with regard to construction. Quality vs Safety.

Management of accidents/injuries: Provision of first aid.

Case Studies.

Reference books

1. B.A. Gilly, A. Touran, and T. Asai, "Quality Control Circles in Construction," ASCE Journal of Construction Engineering and Management, Vol. 113, No. 3, 1987, pg 432.
2. “Improving Construction Safety Performance, Report A-3”, The Business Roundtable, New York, NY, January 1982.
3. Hinze, Jimmie W., “Construction Safety”, Prentice-Hall, 1997.
4. E. Elinski, “External Impacts of Reconstruction and Rehabilitation Projects with Implications for Project Management, Unpublished MS Thesis”, Department of Civil Engineering, Carnegie Mellon University, 1985.

CST 525 Composite Structures

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome	Upon completion of this course the students will be familiar with:
CO1	Composite Systems: Materials, loadings
CO2	Composite Beams: analysis and design
CO3	Analysis of composite columns
CO4	Design of restraining systems and time dependent effects

Composite Systems: Materials, loadings, composite floor systems, composite building systems, methods of analysis. Composite Beams: Components and systems, fundamentals of composites action, shear connection, design for flexure, serviceability. Composite Columns: Types of composite compression members, behavior of composite columns, special considerations. Lateral Resisting System: Types of bracing, moment resisting frames, braced frames, shear-wall design and horizontal diaphragms, joints. Time dependent effects: Creep, shrinkage, thermal effects.

Reference Books

1. Johnson R. P. – Composite Structures of Steel and Concrete, Vol I, Beams, Columns and Frames in Buildings, Oxford Blackwell Scientific Publications.
2. INSDAG teaching resources for structural steel design Vol – 2, Institute for Steel Development and Growth Publishers, Calcutta.
3. INSDAG Handbook on Composite Construction – Multi-Storey Buildings, Institute for Steel Development and Growth Publishers, Calcutta.
4. IS:11384- Code of Practice for Composite Construction in Structural Steel and Concrete, Bureau of Indian Standards, New Delhi.

CST 517 Maintenance and Rehabilitation of Constructed Facilities

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome	Upon completion of this course the students will be familiar with:
CO1	Construction materials and components in services
CO2	Principles of assessment of weathering and durability
CO3	Diagnosis of construction failures
CO4	Maintenance Inspection and planning

Performance of construction materials and components in services; Causes of deterioration; preventive measurements and maintenance; Principles of assessment of weathering and durability; Characteristics of materials; Diagnosis of construction failures; Dealing with cracks; Methods of repair in concrete, Steel and timber structural components; Corrosion damage of reinforced concrete and its repair and prevention measures; Surface deterioration, Efflorescence, causes, prevention and protection; Surface coatings and painting; Water proofing; Grouting; Strengthening of existing structures; Special repairs, maintenance Inspection and planning.

Text and Reference books

1. A.C. Panchadari, “Maintenance of Buildings”, New age international (P) limited Publishers.
2. H.J. Eidridge, “Common Defects in Buildings”, Her Majesty's Stationery Office, London.
3. W.H. Ransom, “Building Failures : Diagnosis and Avoidance”.
4. “Housing defects reference Manual”, The Building Research Establishment”, E & F.N.SPON.
5. Geoffrey K. Cook, Dr. A John Hinks, “Appraising building defects: Properties on stability and hygro-thermal performances”, Longman Scientific & Technical.
6. “Repair of Concrete damaged by reinforcement Corrosion Report of working party”, The concrete society.
7. R Chudley, “The maintenance and adaption of buildings” Longman Technical Services.
8. “Common building defects - Diagnosis & Remedy”, Competed by National Building Agency.
9. J. Barton. N. Ellis “Maintenance and Repair of Buildings and their internal environment”.
10. A.C. Panchdheri “Maintenance of Buildings”.

CST 518 Advanced Solid Mechanics

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome	Upon completion of this course the students will be familiar with:
CO1	Stress and strain at a point; Compatibility conditions
CO2	Generalized Hook’s law for Isotropic, Orthotropic, Transversely Isotropic materials
CO3	Relationship between Cartesian and Polar coordinate system, stress and strain & strain and displacements; Stress concentration problems
CO4	Assumptions and Torsion equation for general prismatic solid bars

Concept of stress at a point, stress tensor, stress on inclined plane, stress components on a rectangular parallelepiped in Cartesian coordinate system, derivation of stress equilibrium equations, transformation of stresses, stress invariants. The state of strain at a point, strain displacement relations, strain compatibility condition and stress compatibility conditions.

Generalized Hook's law for Isotropic, Orthotropic, Transversely Isotropic materials, plane stress, plane strain and axisymmetric problems, Problems in 2D Cartesian coordinate system, Airy's stress function, bending of beams.

Relationship between Cartesian and Polar coordinate system, Equilibrium equations, Strain displacement relations, Stress-strain relationship, Strain-displacement relationship for plane stress and plane strain conditions, Bending of curved bar, Stress concentration problems.

Assumptions and Torsion equation for general prismatic solid bars, Warping of Non-circular sections and St. Venant's theory. Prandtle's stress function approach. Torsion of Circular, Elliptical and Triangular cross-section bar. Torsion of thin-walled structures by membrane analogy, Torsion of rolled sections and shear flow.

Reference Books

1. Timoshenko and Goodier - Theory of Elasticity, McGraw-Hill Publications.
2. S. Crandall, N. Dahl and T. Lardner - Mechanics of Solids, McGraw Hill Publications.
3. Wang - Applied Elasticity, Dover Publications.
4. Irving Shames, Mechanics of deformable solids, Prentice Hall.
5. Scholer, Elasticity in Engineering, McGraw-Hill Publications.
6. L.S. Sreenath – Advanced Mechanics of Solids, Tata McGraw-Hill Publications.
7. S M A Kazimi – Solid Mechanics, Tata McGraw-Hill Publications.

CST 526 Advanced Foundation Design

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome	Upon completion of this course the students will be familiar with:
CO1	Classification and Geotechnical design parameters of foundation design
CO2	Design of Flat slab raft, and beam and slab raft foundation
CO3	Study and design consideration for machines foundations and Pile foundations
CO4	IS code recommendations for structural design for various piles

Foundation objectives and their importance, Classification of foundations. Geotechnical design parameters, bearing capacity, settlements and factors affecting settlement. Loads for design, depth of foundation, Parameters for design of foundation on various types of soil, soil structure interaction.

Types of rafts, Design of Flat slab raft, and beam and slab raft foundation.

Machine Foundation: Introduction, machine vibrations, design of foundations for rotary machines and impact machine, vibration characteristics, design consideration for foundations.

Pile foundations: Function and Classification of piles, Concrete piles, Precast and cast-in-situ piles. Static point and skin resistance capacity of a Pile, Pile settlements, Laterally loaded Piles. Various pile group patterns, Efficiency of Pile in group, Negative skin friction.

IS code recommendations for structural design for various piles. Design of RC cast-in-situ and precast pile by IS code method. Pile group analysis by rigid and flexible methods, Design of pile cap.

Reference Books

1. Kurain N.P - Modern Foundations: Introduction to Advance Techniques: Tata McGraw Hill, 1982.
2. Kurain N. P. - Design of foundation systems Principles and Practice, Narosa Publishing house, New Delhi, 2005.
3. Dr. H.J. Shah, Reinforced Concrete, Vol II, Charotar Publishing House.
4. Winterkorn H.F. and Fang H.Y. Ed., Foundation Engineering Hand Book, Van-Nostrand Reynold, 1975.
5. Bowles J.E., Foundation Analysis and Design (4th Ed.), Mc.Graw –Hill, NY, 1996.
6. Leonards G. Ed., Foundation Engineering, Mc.Graw-Hill, NY, 1962.
7. Shamsher Prakash, Soil Dynamics, McGraw Hill.
8. Sreenivasalu & Varadarajan, Handbook of Machine Foundations, Tata McGraw Hill.
9. IS 1904: Code of practice for design and construction of foundations in soils.
10. IS 2911: Part 1 : Sec 1 to3 : Code of practice for design and construction of pile foundations: Part 1 Concrete piles.
11. IS 2911: Part 1: Sec 4: Code of practice for design and construction of pile foundations: Part 1 Concrete piles.
12. IS 2911: Part 3: Code of practice for design and construction of pile foundations: Part 3 Under-reamed piles.
13. IS 2950: Part 1: Code of Practice for design and construction of raft foundations: Part 1 Design.
14. IS 2974: Part 1to 5: Code of practice for design and construction of machine foundations.
15. IS 9456 Code of practice for design and construction of conical and hyperboloidal types of shell foundations.

CST 527 Tall Buildings

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome	Upon completion of this course the students will be familiar with:
CO1	Tall building- philosophy, design loading
CO2	Structural systems of tall buildings
CO3	Shear walls: structural behavior
CO4	Tubular Structures, Approximate and matrix oriented methods of design of tall buildings

Tall building- philosophy, design loading- types, sequential and simultaneous loading- Gravity, wind and earthquake and combination of loading, creep shrinkage and temperature effects.

Structural systems of tall buildings: Introduction of floor systems (RCC and steel Framing); Behavior of moment resistant frames, braced frames.

Shear walls: structural behavior, proportionate and non-proportionate structures, behavior of coupled shear walls, frame shear wall interaction.

Tubular Structures- Behavior of different type of tube structures.

Approximate and matrix oriented methods of design of tall buildings.

Reference Books

1. Taranath B.S., Structural Analysis and Design of Tall Building, McGraw Hill.
2. Wulf,Gang Schuller, High Rise Building Structures, John Wiley and Sons.
3. Bryan stafford Smith, Alexcoull, Tall Building Structures , Analysis and Design, John Wiley and Sons, Inc,.
4. T.Y.Lin, D.Stotes Burry, Structural Concepts and system for Architects and Engineers. John Wiley.
5. Lynn S.Beedle, Advances in Tall Buildings, CBS Publishers and Distributors, Delhi.

CST 531 Finite Element Methods

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome	Upon completion of this course the students will be familiar with:
CO1	Structural mechanics. Nodal degree of freedom and generalized coordinates
CO2	Isoparametric elements; computation of stiffness matrix, direct stiffness method
CO3	One Dimensional Elements and Two dimensional planar bodies
CO4	Assemblage of elements, Boundary Conditions and Solution of overall problems

Basic principles of structural mechanics, principle of virtual work, energy principles, element properties; relation between nodal degrees of freedom and generalized coordinates, convergence requirements, natural coordinate systems, shape functions, element stiffness matrix.

Isoparametric elements; computation of stiffness matrix for iso-parametric elements, direct stiffness method of analysis and solution technique, assemblage of elements, direct stiffness method, boundary conditions and reaction, basic steps in finite element analysis.

One Dimensional Elements: Shape Functions & Interpolation Polynomials, Refined elements.

Finite Elements for Two Dimensional Planar Bodies. Triangular Elements for Plane Stress or Strain Conditions. Higher Order Triangular Elements. Rectangular Elements for Plane Stress or Strain Conditions.

Assemblage of elements, Boundary Conditions and Solution of overall problems.

Reference Books

1. J.N. Reddy – An Introduction to the finite element method – Tata McGraw Hill Publishing Co. Ltd.
2. C.S. Krishnamoorthy – Finite Element Analysis – Theory & Programming – Tata McGraw Hill Publishing Co. Ltd.
3. Zienkiewicz & Taylor - The Finite Element Method 4th Edition – Vol – I & II –McGraw Hill International Edition.
4. G.R. Buchanan – Finite Element Analysis Schaum's outlines - Tata McGraw Hill Publishing Co. Ltd.
5. S.S. Bhavikatti - Finite Element Analysis – New Age International Publishers, Delhi.
6. S.S. Rao - The Finite Element Method in Engineering 4th Edition – ELSEVIER Publication.
7. Robert D. Cook, D.S. Malkus, M.E. Plesha – Concepts & Applications of Finite Element Analysis – John Wiley & Sons.

CST 532 Bridge Engineering

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome	Upon completion of this course the students will be familiar with:
CO1	Classification and components of bridges layout and planning, IRC loadings
CO2	Design of Culverts, Courbon's method, Henry-Jaegar method and Guyon-Massonet method
CO3	Classification and design of bearings. Expansion joints. Forces acting on abutments and piers, analysis and design, types and design of wing walls
CO4	Bridge foundations, design of open well, pile and caisson foundation

Introduction to bridge engineering, classification and components of bridges, layout, planning. Structural forms of bridge decks, beam and slab decks, cellular decks. Standard specification for bridges, IRC loadings for road bridges, loading standards for railway bridges.

Design of slab culvert, box culvert.

Introduction to Courbon's method, Henry-Jaegar method and Guyon-Massonet method. Design of T-beam PC bridges using Courbon's method.

Classification and design of bearings. Expansion joints. Forces acting on abutments and piers, analysis and design, types and design of wing walls.

Bridge foundations, design of open well, pile and caisson foundation.

Reference Books

1. D. Johnson Victor - Essentials of Bridge Engineering Fifth Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. T.R. Jagadeesh, M.A. Jayaram - Design of Bridge Structures, Prentice-Hall of India.
3. N. Krishna Raju - Design of Bridges, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. David Lee – Bridge Bearings and Expansion Joints, E & FN Spon.
5. V.K. Raina – Concrete Bridge Practice Analysis, design and Economics, Tata McGraw Hill
6. IRC Codes – IRC: 5, IRC: 6, IRC: 18, IRC: 27, IRC: 45, IRC: 78, IRC: 83.
7. Joseph E. Bowles – Foundation Analysis and Design, McGraw-Hill International Edition.
8. Nainan P. Kurian – Design of Foundation Systems, Narosa Publishing House.

CST 533 Earthquake Resistant Structures

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome	Upon completion of this course the students will be familiar with:
CO1	Sesmic loads, design and analysis
CO2	Design of multi-storey RC structure
CO3	Seismic design of multi-storey steel structures with various bracing systems, two storey masonry buildings
CO4	Seismic retrofitting, Classification of retrofitting techniques, Introduction to Base Isolation systems. IS code provisions for retrofitting

Earthquake effects on the structures, classification of loads, Seismic methods of analysis, seismic design methods. Seismic damages during past earthquakes and effect of irregularities and building architecture on the performance of RC structures.

Design of multi-story RC structure with foundation as per latest IS: 1893 by Equivalent static lateral load method and Response Spectrum Method. Introduction to Time history method. Ductile detailing as per latest IS:13920.

Seismic design of multi-storeyed steel structures with various bracing systems. Lateral load analysis and design of two- storied masonry buildings.

Seismic retrofitting, Sources of weakness in RC framed buildings, Classification of retrofitting techniques, Conventional and non-conventional methods, Comparative study of various methods and case studies. Introduction to Base Isolation systems. IS code provisions for retrofitting of masonry structures, failure modes of masonry structures and repairing techniques.

Reference Books

1. P. Agarwal and M. Shrikhande – Earthquake Resistant Design of Structures, Prentice-Hall Publications.
2. IS:1893 – Indian Standard Criteria for Earthquake Resistant Design of Structures, Bureau of Indian Standards, New Delhi.
3. IS:13935 – Repair and Seismic Strengthening of Buildings – Guidelines.
4. IS:4326 – Earthquake Resistant Design and Construction of Buildings – Code of Practice.
5. IS:13828 – Improving Earthquake Resistance of Low Strength Masonry Buildings.
6. IS:13827 - Improving Earthquake Resistance of Earthen Buildings.
7. IS:13920 – Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Force.
8. Clough and Penzin – Dynamics of Structures, Mc-Graw Hills Publications.

CST 534 Disaster Reduction and Management

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome	Upon completion of this course the students will be familiar with:
CO1	Design parameters of Earthquake resistant structures
CO2	Codal provisions, planning and design aspects
CO3	Information management, precautions
CO4	Management of relief and rehabilitation

Introduction to Earthquake resistant structures and design parameters, Principles and philosophies, Codal provisions, Factors affecting damage to structures, Enforcement of codal provisions, Effective rescue operation, General planning and design aspects, Conventional earthquake resistant design, Seismic base isolation method, retrofitting, Training and lecturing at various levels, Preparedness to meet earthquake disaster, Programmes for public awareness, demonstrations and exhibitions, Information management (Safety, emergencies, management and planning, design, response, user experience problems and case studies), Proper land use practices, long term disaster preparedness measures. Precautions after a major earthquake, Preparedness for medical supply Emergency care (First aid, Home remedies).

Management cell, Central crisis management core group, damage reconnaissance, Management of relief and rehabilitation (Infrastructure rehabilitation, Housing rehabilitation, Social rehabilitation), Role of volunteers, Emergency operation centres, Information system, Cooperation with local authority, Coordination for international relief, Role of government, NGO's, Role of remote sensing in relief operations.

Reference books

1. Pardeep Sahni, Alka Dhameja, and Uma Medury, “Disaster Mitigation Experiences & Reflections”.
2. “Disaster Management Report by Department of Agriculture and Cooperation”, Govt. of India.

Note:

1. For supporting courses course description, which are offered by other departments, refer separately syllabus of that particular department.
2. For syllabus of Non-Credit Compulsory Courses, see at the end.

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DEPARTMENT OF COMPUTER SCIENCE ENGINEERING

VISION

To contribute to India and the World through excellence in the Domain of Computer Science and Engineering education and research and to serve as a valuable resource for Computer Science and Engineering based Industry and society at-large.

MISSION

- Committed to excellence, the department seeks to impart knowledge to develop latest technological skills with value based education among students to facilitate their development as successful and competent professionals for the nation.
- Promote excellence, foster high standards and orient the education towards future needs and opportunities through strong Academia, Industry, and Stakeholder linkages.
- Strengthen the curricula as per the current needs of the industry and academia to promote research and development in frontier areas of Computer Science & Engineering.
- Provide opportunities for research, continuing education, faculty up-gradation and development of human resources in new and cutting edge technologies, especially through national and international collaboration.
- Strengthen non-formal training and Research to promote innovation among students and equip them to be successful future entrepreneurs and researchers.

Program Educational Objectives

1. Apply computer science theory blended with mathematics and engineering to model computing systems.
2. Design, implement, test and maintain software systems based on requirement specifications.
3. Communicate effectively with team members, engage in applying technologies and lead teams in industry.

4. Assess the computing systems from the view point of quality, security, privacy, cost, utility, etiquette and ethics.
5. Engage in lifelong learning, career enhancement and adapt to changing professional and community needs.

Program Outcome

1. Design algorithms for real world computational problems and analyze their complexities.
2. Design, develop and maintain computing systems using concepts from mathematics, engineering and program's core courses.
3. Design and develop computing applications with professional expertise to solve complex problems of the computer and information technology
4. Design and develop interfaces among subsystems of computing.
5. Analyze large data samples and discover knowledge to provide solutions to engineering problems.
6. Assess security, privacy, quality and cost parameters in developing software systems.
7. Communicate effectively and practice professional ethics with societal responsibilities.
8. Engage in lifelong learning through independent study of new techniques and tools.
9. Work in teams using common tools and environment to achieve project objectives.

Semester-wise Scheme for Post Graduate Programme in Computer Science and Engineering

Details of courses offered for the award of M.Tech. (CSE) in Computer Science and Engineering

S. No.	Title	Course No.	Cr. Hr.	Semester			
				I	II	III	IV
Core Courses: Total 12 credits, two courses in first semester (6 credits) and one course in second and third semester (3 credits each) to be evaluated externally.							
1.	Distributed Computing	CSE 511	3 (2+1)	3	-	-	-
2.	Mobile Computing	CSE 512	3 (2+1)	3	-	-	-
3.	Multimedia Computing	CSE 521	3 (2+1)	-	3	-	-
4.	Advance Operating Systems	CSE 531	3 (2+1)	-	-	3	-
Optional (Major) Courses: Total 15 credits, two courses in first and second semester each (6 credits in each semester) and one course in third semester (3 credits).							
1.	Embedded Systems Design	CSE 513	3 (3+0)	3	-	-	-
2.	Distributed Database Management Systems	CSE 514	3 (2+1)	3	-	-	-
3.	Fault Tolerant Computing	CSE 515	3 (3+0)	3	-	-	-
4.	Intelligent Systems	CSE 516	3 (3+0)	3	-	-	-
5.	Digital Image Processing	CSE 517	3 (3+0)	3	-	-	-
6.	Interconnection Networks	CSE 522	3 (2+1)	-	3	-	-
7.	Advance Network Security	CSE 523	3 (2+1)	-	3	-	-
8.	Information Retrieval	CSE 524	3 (3+0)	-	3	-	-
9.	Data Storage Technology	CSE 525	3 (3+0)	-	3	-	-
10.	Software Testing	CSE 526	3 (3+0)	-	3	-	-
11.	Soft Computing	CSE 527	3 (2+1)	-	3	-	-
12.	Computer Graphics	CSE 532	3 (3+0)	-	-	3	-
13.	Data Mining Technology	CSE 533	3 (2+1)	-	-	3	-
14.	Machine Learning	CSE 534	3 (3+0)	-	-	3	-
15.	Watermarking and Steganalysis	CSE 535	3 (2+1)	-	-	3	-
Minor & Supporting Courses: Total 9 credits; one course in first, second and third semester each (3 credits in each semester).							
1.	Optimization Techniques	BS 514	3 (3+0)	3	-	-	-
2.	Higher Mathematics	BS 515	3 (3+0)	3	-	-	-
3.	Information Processing and Coding Techniques	ECE 515	3 (3+0)	3	-	-	-
4.	Methods of Numerical Analysis	BS 521	3 (3+0)	-	3	-	-
5.	Telecommunication Switching & Networks	ECE 522	3 (2+1)	-	3	-	-
6.	Advance VLSI Design	ECE 524	3 (2+1)	-	3	-	-
Others							
	Compulsory Courses; {(0+1) or (1+0)} Non Credit (NC); PGS Series	PGS501/502/...	1	NC	NC	-	-
	Seminar (0+1)	CSE 536	1	-	-	1	-
	Comprehensive	CSE 537	NC			NC	
	Research (Thesis). Thesis minimum duration 2 semesters	CSE 538	20	-	-	-	20
	Total credits to be offered (for Master Programme)		**57**	**15**	**12**	**10**	**20**

COURSE SUMMARY

Courses	No. of Courses					Credit Hours
	Semester					
	I	II	III	IV	Total	
Core	2	1	1	-	4	12
Optionnal (Major)	2	2	1	-	5	15
Minor & Supporting	1	1	1	-	3	9
Seminar	-	-	1	-	1	1
Comprehensive	-	-	-	1	1	Non Credit (graded as satisfactory/ non satisfactory)
Research (Thesis)	-	-	-	1	1	20* (graded as satisfactory/ non satisfactory)
Compulsory Courses (PGS Series)	1	1	-	-	2	Non Credit
Total	**6**	**5**	**4**	**2**	**17**	**57**

*Research (Thesis) credit load is not counted in calculation of final OGPA.

Details of courses offered for the award of Ph.D. (CSE) in Computer Science and Engineering

S. No.	Title	Course No.	Cr. Hr.	Semester			
				I	II	III	IV-VI
Core Courses: Total 6 credits (3 credits in each semester), one course in first semester and one course in second semester to be evaluated externally.							
1.	Wireless Network Technologies	CSE 611	3 (2+1)	3	-	-	-
2.	Advance Computer Architectures and Distributed Processing	CSE 621	3 (2+1)	-	3	-	-
Optional (Major) Courses: Total 12 credits (6 credits in each semester) two courses in first and second semester each.							
1.	Embedded Systems Design	CSE 513	3 (3+0)	3	-	-	-
2.	Distributed Database Management Systems	CSE 514	3 (2+1)	3	-	-	-
3.	Fault Tolerant Computing	CSE 515	3 (3+0)	3	-	-	-
4.	Intelligent Systems	CSE 516	3 (3+0)	3	-	-	-
5.	Digital Image Processing	CSE 517	3 (3+0)	3	-	-	-
6.	Real Time Computing	CSE 612	3 (3+0)	3	-	-	-
7.	Grid Computing	CSE 613	3 (3+0)	3	-	-	-
8.	Advance Algorithms and Applications	CSE 614	3 (2+1)	3	-	-	-
9.	Graphics and Visualization	CSE 615	3 (3+0)	3	-	-	-
10.	Interconnection Networks	CSE 522	3 (2+1)	-	3	-	-
11.	Advance Network Security	CSE 523	3 (2+1)	-	3	-	-
12.	Information Retrieval	CSE 524	3 (3+0)	-	3	-	-
13.	Data Storage Technology	CSE 525	3 (3+0)	-	3	-	-
14.	Software Testing	CSE 526	3 (3+0)	-	3	-	-
15.	Soft Computing	CSE 527	3 (2+1)	-	3	-	-
16.	Unix Operating System Design	CSE 622	3 (2+1)	-	3	-	-
17.	Modeling and Simulation	CSE 623	3 (3+0)	-	3	-	-
18.	Cloud Computing	CSE 624	3 (3+0)	-	3	-	-
19.	Web Engineering	CSE 625	3 (2+1)	-	3	-	-
20.	Video Communications	CSE 626	3 (2+1)	-	3		
21.	Computer Graphics	CSE 532	3 (3+0)	-	-	3	-
22.	Data Mining Technology	CSE 533	3 (2+1)	-	-	3	-
23.	Machine Learning	CSE 534	3 (3+0)	-	-	3	-
24.	Watermarking and Steganalysis	CSE 535	3 (2+1)	-	-	3	-
Minor & Supporting Courses: Total 9 credits; two courses in first semester (6 credits) and one course in second semesters (3 credits).							
1.	Optimization Techniques	BS 514	3 (3+0)	3	-	-	-
2.	Higher Mathematics	BS 515	3 (3+0)	3	-	-	-
3.	Information Processing and Coding Techniques	ECE 515	3 (3+0)	3	-	-	-
4.	Numerical analysis of Differential Equations	BS 611	3 (3+0)	3	-	-	-
5.	Methods of Numerical Analysis	BS 521	3 (3+0)	-	3	-	-
6.	Telecommunication Switching & Networks	ECE 522	3 (2+1)	-	3	-	-
7.	Advance VLSI Design	ECE 524	3 (2+1)	-	3	-	-
8.	Advanced Mathematics for Computing	BS 621	3 (3+0)	-	3	-	-

Others							
	Compulsory Courses+; {(0+1) or (1+0)} Non Credit (NC); PGS Series	PGS501/ 502/...	1	NC	NC		
	Seminar	CSE 691/692	1 (0+1)	1	1	-	-
	Preliminary	CSE 632	NC			NC	
	Research (Thesis). Thesis minimum duration 4 semesters	CSE 633	45	-	-	-	45
	Total credits to be offered		**74**	**16**	**13**	**-**	**45**

Note: A Ph.D. student must take two 600 series core courses. A student may choose optional/minor & supporting courses of 500 series courses if not studied during Masters Programme as per ICAR guidelines.

\+ Exempted for those who have cleared these in Master's Programme (permission to be sought from the Dean, CTAE).

COURSE SUMMARY

Courses	No. of Courses							Credit Hours
	Semester							
	I	II	III	IV	V	VI	Total	
Core	1	1	-	-	-	-	2	6
Optional (Major)	2	2	-	-	-	-	4	12
Minor & Supporting	2	1	-	-	-	-	3	9
Seminar	1	1	-	-	-	-	2	2
Preliminary	-	-	1	-	-	-	1	Non Credit (graded as satisfactory/ non satisfactory)
Research (Thesis)	-	-	-	-	-	1	1	45* (graded as satisfactory/ non satisfactory)
Compulsory Courses** (PGS Series)	1	1	-	-	-	-	2	Non Credit
Total	**7**	**6**	**1**	-	-	**1**	**15**	**74**

*Research (Thesis) credit load is not counted in calculation of final OGPA.

**Exempted for those who have cleared these in Master's Programme

SYLLABUS

COMPUTER SCIENCE AND ENGINEERING

CSE 511 DISTRIBUTED COMPUTING

	L	T	P
Credits	2	0	1
Hours	2	0	2

Distributed computing system characterization, challenges & examples, interprocess communication, external data representation, marshalling, client server communications, IPC in UNIX.

Communication between distributed objects, distributed object model, design issues of RMI, distributed garbage collection, Sun RPC and Java RMI.

Name services and Domain name system, directory & discovery services, time & global states, synchronizing physical clock, logical time and logical clocks.

Transactions, nested transactions, locks, optimistic concurrency control, time stamp ordering, distributed transactions, flat and nested distributed transactions, atomic commit protocols in distributed transactions, concurrency control in distributed transactions, distributed deadlocks, transaction recovery.

Practicals: Based on theory.

Text/References

1. George Coulouris, Jean Dollimore and Tim Kindberg. Distributed Systems, Concepts and Design, Addission Wesley.
2. A.S. Tanenbaum and M.S. Steen. Distributed System: Principles and Paradigms, Pearson Education.

CSE 512 Mobile Computing

	L	T	P
Credits	2	0	1
Hours	2	0	2

The cellular concepts and its implementations, analog and digital cellular mobile system, cellular mobile systems, wireless systems**,** channel allocation, multiple access, location management, handoffs. Mobile network and transport layers and protocols, general study of 4-G mobile communication systems.

Wireless Networking: MAC protocols, routing, transport, Ad-hoc networking. Wireless LAN architecture, mobility in wireless LAN, mobile Ad-Hoc networks & sensor networks, wireless LAN security, energy efficient computing, impact of mobility on algorithms.

Applications: mobility adaptations, disconnected operations, data broadcasting, mobile agents.

Practicals: Based on theory.

Text/References

1. Asoke k Talukdar and Roopa R Yavagal. Mobile Computing, Tata Mc-Graw Hill.
2. William Stallings. Wireless Communications & Networks, Pearson Education.
3. John Schiller. Mobile Communications, Pearson Education.
4. T.S. Rappaport. Wireless Communications, Principles & Practices.

CSE 513 Embedded Systems Design

	L	T	P
Credits	3	0	0
Hours	3	0	0

Design challenges, processor, technology, IC technology, design technology. Custom single purpose processor: Custom single purpose processor design, operation, programmer view, development environment, application specific instruction set processor, selecting a microprocessor.

Standard single purpose processor peripherals, timers counters, watchdog timers, UART, pulse with modulator, LCD controller, keypad controller, APC, real time clocks. Memory: memory write ability and storage performance. Common memory types, composing memories, memory hierarchy and cache, advanced RAM: DRAM, FPMDRAM, EDO DRAM, SDRAM, RDRAM, memory management unit.

Interfacing: arbitration, multi-level bus architectures, serial protocols: 12C bus, CAN bus, fire wire bus, USAB, parallel protocols: PCI and ARM bus, wireless protocols: 1rdA, Bluetooth, IEEE 802.11.

Control systems: open loop and closed loop systems, general control systems and PID controllers, fuzzy control, practical issues related to computer based control, benefits of computer based control implementations.

Text/References

1. Frank Vohid and Tomy Givargi. Embedded System Design: A Unified Hardware/software Introduction, wiley.
2. Raj Kamal. Embedded System: Architecture, Programming and Design, Tata McGraw Hill Publication.

CSE 514 Distributed Database Management Systems

	L	T	P
Credits	2	0	1
Hours	2	0	2

Concepts and design of distributed database systems, data fragmentation, replication, and allocation techniques for DDBMS, methods for designing and implementing DDBMS, designing a distributed relational database, architectures for DDBMS cluster, federated, parallel databases and client server architecture.

Advanced concepts in DDBMS: overview of distributed management, atomicity, consistency, isolation, durability, two phase locks, time stamp ordering, optimistic concurrency control, concurrency and recovery in DDBMS, distributed deadlock management, transaction recovery and replication servers, distributed query processing and optimization. Current trends and developments related to distributed database applications technologies.

Introduction to related database technologies: parallel databases, mobile database and web databases.

Practicals: Based on theory.

Text/References

1. M. Tomer Ozsu and P. Valduriez. Principles of Distributed Database Systems, Pearson Education.
2. S. Ceri and G. Pelagapati. Distributed Database, Principles and Systems, McGraw Hill Publication.

CSE 515 Fault Tolerant Computing

	L	T	P
Credits	3	0	0
Hours	3	0	0

Fault tolerant concepts and an example showing the scope of the course, hardware redundancy technique: passive, active, hybrid information redundancy, coding information redundancy, self-checking, time redundancy, software redundancy.

Fault modeling: fault characteristics, fault modeling, introduction models at different levels gate level, function level, system level, Error models, system fault models and high level failure models, modeling other faults.

Test generation and fault simulation: introduction and basics of testing, complexity of testing and complexity reduction methods.

System level diagnosis: system and system test model, one-step diagnosis – design other models, sequential diagnosis.

Software reliability: towards zero-defects, life cycle phases, factors affecting defect density, reliability growth process, fault exposure ratio, use of SRGMs, coverage and reliability, multi-component systems.

Text/References

1. B.W.Johnson. Design and Analysis of Fault-Tolerant Digital Systems, Addison-Wesley.
2. K.S.Trivedi. Probability and Statistics with Reliability, Queueing and Computer Science Application, Prentice Hall.

CSE 516 Intelligent Systems

	L	T	P
Credits	3	0	0
Hours	3	0	0

Artificial intelligence, intelligent agents, solving problems by searching, informed search methods, game playing.

Neural networks, basic neural computational models learning: supervised versus unsupervised, knowledge based neural networks, mathematical modeling.

Expert Systems: knowledge acquisition and representation, inference engines, reasoning under uncertainty, hybrid expert systems, fuzzy logic and neural networks.

Text/References

1. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach, Pearson Education Asia.
2. Li Min Fu. Neural Networks in Computer Intelligence, TMH.
3. B. Kosko. Neural Networks and Fuzzy Systems: A Dynamical systems approach to machine intelligence, PHI.

CSE 517 Digital Image Processing

	L	T	P
Credits	3	0	0
Hours	3	0	0

Origins of digital image processing, application area, components of an image processing system. Elements of visual perception, light and the electromagnetic spectrum, image sensing and acquisition, image sampling and quantization, relationships between pixels.

Image enhancement in the spatial domain: background, gray level transformations, histogram processing, enhancement using arithmetic/logic operations, spatial filtering, smoothing spatial filters, sharpening spatial filters, combining spatial enhancement methods.

Image enhancement in the frequency: introduction to the Fourier transform and the frequency domain, smoothing frequency-domain filters, sharpening frequency domain filters, homomorphic filtering, implementation.

Image restoration: model of the image degradation/restoration process, noise models, restoration in the presence of noise only–spatial filtering, periodic noise reduction by frequency domain filtering, linear, position-invariant degradations, estimating the degradation function, inverse filtering, minimum mean square error (wiener) filtering, constrained least squares filtering. Geometric mean filter, geometric transformations.

Color image processing: color fundamentals, and models, color image processing, transformations, smoothing and sharpening, color segmentation. Wavelets and multiresolution processing: multiresolution expansions, wavelet transforms in one dimension, fast wavelet transform, wavelet transforms in two dimensions.

Image compression: image compression models, error-free compression, lossy compression, image compression standards.

Text/Reference

1. Rafael C. Gonzalez and Richard E. Woods. Digital Image Processing, Pearson Education.
2. Gonzalez R and Wood R. E. Digital Image Processing, Prentice Hall of India.

BS 514 Optimization Techniques

	L	T	P
Credits	3	0	0
Hours	3	0	0

Introduction: historical development, application to engineering problems, statement of optimization, classification of optimization, examples of optimization problems. Optimization: calculus based methods, lagrange multiplier.

Non-linear programming: unconstrained optimization techniques, constrained optimization, direct and indirect methods, kuhn-tucker conditions.

Linear programming: graphical method, simplex method, revised simplex method, big-M method, 2-phase method, unbounded LPs, degeneracy and convergence, duality in linear programming, sensitivity analysis, dual simplex method.

Transportation problem: north-west corner rule, row-minimum method, Vogel's approximation. Dynamic programming: multistage decision process, principles of optimality, computational procedures in dynamic programming.

Text/References

1. S.S. Rao. Engineering optimization: Theory and practice, New Age International (P) Ltd, New Delhi.
2. H. Taha. Operation research: An introduction, Prentice Hall, India.

BS 515 Higher Mathematics

	L	T	P
Credits	3	0	0
Hours	3	0	0

Complex variables: analytic functions, cauchy-riemann equations, harmonic functions, construction ofanalytic functions. Conformal mapping: elementary transformations, bilinear mapping. Complex integration: cauchy's integral theorem, cauchy's integral formula and derivatives of an analytic function. Taylor's and laurent's series. Classifications of singularities, residue of functions, cauchy's residue theorem; evaluation of real integrals by means of calculus of residue.

Special functions: error function, fresnel integrals, sine and cosine integrals. Bessel function, bessel's differential equation, recurrence relations, orthogonal property and generating function. Legendre polynomials, legendre differential equation, rodringue's formula, recurrence relations, orthogonal property and generating function.

Text/References

1. G.N. Purohit and S.P. Goyal. Complex Analysis, Jaipur Publishing House, Jaipur.
2. B.S. Tyagi. Functions of Complex Variables, Kedarnath Ramnath, Meerut.
3. J.L. Bansal and H.S. Dhami. Differential Equations (Vols.-II), Jaipur Publishing House, Jaipur.
4. R.K. Jain and S.R.K. Iyengar. Advanced Engineering Mathematics, Narosa Publishing House, New Delhi.

ECE 515 Information Processing and Coding Techniques

	L	T	P
Credits	3	0	0
Hours	3	0	0

Shannon's fundamental coding theorems, differential entropy & mutual information for discrete & continuous ensembles, source coding, rate distortion theory.

Introduction to algebra: groups, fields, binary field arithmetic, basic properties of galois field GF (2m) and vector spaces.

Channel coding & decoding: run length limited codes, LBC, cyclic code, BCH code, convolutional code, trellis coded modulation, reed-solomon code.

Text/References

1. F.M Reza. Information Theory: McGraw Hill.
2. K.Sam Shanmugam. Digital and Analog Communication Systems, John Wiley.
3. Singh & Sapre. Communication Systems: Analog and Digital, TMH.
4. B. Sklar. Digital Communication, Pearson Education Asia.

CSE 521 Multimedia Computing

	L	T	P
Credits	2	0	1
Hours	2	0	2

Multimedia authoring and data representation: component of multimedia, multimedia software tools, multimedia authoring and tools. Graphic and Image data representations: graphic and image data types, popular file format. Colour models in images and video.

Video and audio: types of video signals, analog video, digital video, digitization of sound, musical instrument digital interface (MIDI), quantization and transmission of audio.

Multimedia data compression: lossless and lossy compression algorithms, image compression standards, video compression techniques, MPEG video coding-I (MPEG-1 and MPEG-2), MPEG video coding (MPEG-4 and MPEG-7 and beyond), audio compression techniques. MPEG audio compression.

Multimedia communication: computer and multimedia networks, multiplexing techniques, quality of multimedia data transmission, Multimedia over IP, transport of MPEG-4 video, video-on-demand, multimedia over wired and wireless network. Multimedia applications: media preparation, media composition, media integration, media communication, media entertainment.

Practicals: Based on theory.

Text/References

1. Ralf Steinmetz and Klara Nahrstedt. Multimedia Computing, Communication and applications, Pearson Education.
2. Ze-Nian Li and Mark S. Drew. Fundamentals of Multimedia, Pearson Education.
3. Fred Halsall. Multimedia Communications, Pearson Education.

CSE 522 Interconnection Networks

	L	T	P
Credits	2	0	1
Hours	2	0	2

Shared medium networks, direct networks, indirect networks, multiple backplane buses, hierarchical networks, and cluster based networks.

Message switching layer: circuit switching, packet switching, virtual cut-through switching, wormhole switching, mad postman switching, virtual channels.

Deadlock, livelock, and starvation: a theory of deadlock avoidance: network & router model, deadlock avoidance in SAF & VCT switching, deadlock avoidance in wormhole switching, channel classes, central queues, deflection routing, injection limitations, deadlock avoidance in switch based networks, deadlock prevention in circuit switching and PCS, deadlock recovery: deadlock probability, detection of potential deadlocks, progressive and regressive recovery techniques, livelock avoidance.

Routing algorithms: deterministic routing algorithms, partially adaptive routing algorithm: planar adaptive and turn model, fully adaptive algorithms: algorithms based on structured buffer pools, algorithms derived from SAF algorithms, virtual networks, deterministic and adaptive sub networks, maximally adaptive routing algorithms: algorithms with minimum buffer requirement, true fully adaptive routing algorithms, nonminimal routing algorithms, backtracking protocols, routing in switch based networks with irregular topologies, resource allocation policies: selection function, policies for arbitration & resource allocation.

Practicals: Based on theory.

Text/References

1. Jose Duato, Sudhakar Yalamanchili and Lionel M. Ni. Interconnection Networks an Engineering Approach, Morgan Kaufmann.

CSE 523 Advance Network Security

	L	T	P
Credits	2	0	1
Hours	2	0	2

Principle of security, types of attacks, cryptography techniques: plain text and cipher text, substitution techniques, transposition techniques, encryption & decryption, symmetric & asymmetric cryptography, steganography, key range and key size, possible types of attacks.

Computer based symmetric key cryptography algorithms: symmetric key cryptography, DES, IDEA, blowfish, advance encryption standards, computer-based asymmetric key cryptographic algorithms: RSA algorithms, digital signature, MD5, discrete logarithm algorithms.

Public key infrastructure (PKI): digital certificates, private key management, authentication password, authentication tokens, certificate based authentication, biometric authentication, kerberos, single sign on (SSO).

Internet security Protocols: secure socket layer, secure hyper text transfer protocol, time stamping protocol, secure electronic transaction, electronic money, E-Mail security, wireless application protocol (WAP) security, network security: IP security, firewalls, virtual private networks, denial of service attack, IP spoofing attacks, cross site scripting vulnerability, contract signing, secret splitting, virtual elections. Intrusion detection, models, architecture, NIDS, HIDS, network security, network security attacks, applications of cryptography in network security, encryption at different OSI-layers, code based vulnerabilities, policy deployment in network, study of emerging intrusion detection and prevention techniques.

Practicals: Based on theory.

Text/References

1. Atul Kahate. Cryptography and Network Security, Tata McGraw-Hill Publishing Company Ltd.
2. William Stallings. Cryptography and Network Security, Pearson Asia.
3. Bishop and Matt. Introduction to Computer Security**,** Addison-Wesley, Pearson Education, Inc.

CSE 524 Information Retrieval

	L	T	P
Credits	3	0	0
Hours	3	0	0

Need of information retrieval and its comparison with data retrieval. Modeling: formal specifications of IR systems. Set theoretic model: boolean, vector and probabilistic based IR systems. Comparison between searching and browsing.

Performance measures: recall, precision, R-precision, single value summaries. User oriented measures: coverage, novelty, expected search length. Query languages: single and multi word queries, phrase based queries, structural queries, contextual queries, structured text: form based, hierarchical and link based.

Text Processing: information processing, entropy measure, zipf's law, heap's law, growth of vocabulary, logical view of documents, lexical analysis: handling stop-words, punctuations, use of thesaurus, stemming techniques - porter's algorithm, text compression: statistical and dictionary schemes, huffman coding. Inverted lists compression.

Indexing and searching: suffix tries, supra indices, B+ trees and Hashing construction techniques. Substring matching: brute force, KMP, regular expression, shift-or technique, suffix automaton. Web search: issues handling web documents, web crawling, web documents ranking: page rank ranking algorithm.

Text/References

1. Ricardo Baeza Yates and Berthier Ribeiro Neto. Modern Information Retrieval, Addison Wesley Longman Publication Inc.
2. I. Witten, A. Moffat, and T. Bell. Managing Gigabytes, Mc-Graw hill publication.

CSE 525 Data Storage Technology

	L	T	P
Credits	3	0	0
Hours	3	0	0

Storage devices & I/O subsystems: traditional backup devices, disk arrays, disk physical structure-components, properties, performance, and specifications. Tape drives, JBODs, RAIDs, hot spares, storage I/O & storage system connectivity protocols.

Introduction to networked storage: discussion of direct attached storage (DAS), storage area networks (SAN), network attached storage (NAS) and content addressable storage (CAS). Basic architecture, connectivity and management principles.

Information availability: business continuity and disaster recovery basics, local business continuity techniques, Remote business continuity techniques, disaster recovery principles & techniques.

Storage area networks (SAN): SAN components & building blocks, SAN software, data access over SAN. Fiber channel basics, protocols & connectivity. SAN topologies, elements of SAN design, scalability, availability, performance, security, capacity, and manageability issues. Studies and critiques of existing SAN design scenarios (partial mesh, full mesh, core/edge, & tiered designs).

Text/References

1. Marc Farley Osborne. Building Storage Networks, Tata McGraw Hill.
2. Robert Spalding. Storage Networks: The Complete Reference, Tata McGraw Hill.
3. Gupta Meena. Storage Area Network Fundamentals, Pearson Ed.

CSE 526 Software Testing

	L	T	P
Credits	3	0	0
Hours	3	0	0

Testing concepts, issues and planning: purpose, activities, processes and context questions about testing, functional vs structural testing: coverage based vs usage based testing, test planning and preparation: goals, strategies, and techniques, testing models and test cases. Test suite preparation and management, preparation of test procedure, test execution, result checking, and measurement.

Coverage based and boundary testing techniques: checklist-based testing and its limitations, testing for partition coverage, partition: concepts and definitions, testing decisions and predicates for partition coverage, usage-based statistical testing, a case study, input domain partitioning and testing, input domain testing for partition and boundary problems, simple domain analysis and the extreme point combination strategy.

Control flow, data dependency, and integration testing: basic control flow testing, model construction path selection & sensitization, loop testing, CFT Usage, different types of loops and corresponding CFGs, loop testing: difficulties and a heuristic strategy, CFT usage and other issues, data dependency and data flow testing: basic concepts: operations on data and data dependencies, DFT and DDG elements and characteristics .

Testing techniques: adaptation, specialization and integration: testing sub-phases and applicable testing techniques, specialized test tasks and techniques. basic concepts and generic approaches, root cause analysis for defect prevention other techniques for defect prevention, analysis and modeling for defect prevention, software tools to block defect injection.

Software inspection and formal verification: basic concepts and generic process, fagan inspection, other inspections and related activities, code reading, other formal reviews and static analyses, defect detection techniques, tool / process support, and effectiveness.

Text/References

1. Jeff Tian. Software Quality Engineering Testing, Quality Assurance, and Quantifiable Improvement, John Wiley and Sons Inc., and IEEE Computer Society Press.
2. Edwar Dkit. Software testing in the Real World, Pearson Education.
3. William E Perry. Effective Methods for Software Testing, John Wiley and Sons.
4. Stephan H. Kan. Metrics and Models in Software Quality Engineering, Pearson Education.

CSE 527 Soft Computing

	L	T	P
Credits	2	0	1
Hours	2	0	2

Essentials of artificial neural networks & applications, characteristics of ANNs Biological Prototype, Perceptron, Multilayer NN. Learning methods, back propagation, counter propagation, ART, BAM, associative memories.

Fuzzy logic, fuzzy sets, fuzzy model, fuzzy rule generation, fuzzy inference system, defuzzification. Neuro fuzzy systems, architecture and application of a neuro fuzzy system and its applications.

Genetic algorithm: problem solving using GA, applications of GA & GP, hybrid systems

Practicals: Based on theory.

Text /References

1. Jang. Neuro Fuzzy and Soft Computing, Pearson Education.
2. Kecman. Learning and Soft Computing, Pearson Education.
3. Klir and Yuan. Fuzzy Sets and Fuzzy Logic, PHI.
4. Fu. Neural Network in computer Intelligence, TMH.
5. Bart Kosko. Neural Networks and Fuzzy Systems, PHI.
6. Melaine Mitchell. An Introduction to Genetic Algorithm, PHI Course.

BS 521 Methods of Numerical Analysis

	L	T	P
Credits	3	0	0
Hours	3	0	0

Solution of system of linear equations: gaussian elimination method, gauss-jordan method, gauss-seidel method, matrix inversion method. Matrix eigenvalue problem: power method and inverse power method.

Numerical solution ordinary differential equations: taylor's series method, picard's method, euler's and euler's modified method, runge-kutta methods.

Solution of algebraic and transcendental equations: bisection method, false position method, newton raphson method.

Interpolation: forward, backward and central difference operators, shifting and averaging operator, relation between difference operators. Forward and backward interpolation formulae, lagrange's interpolation formula for unequal intervals.

Solution of difference equations: linear difference equations, different forms of particular solutions.

Text /References

1. Babu Ram. Numerical Methods, Pearson Education India.
2. Santosh K. Gupta. Numerical Methods for Engineers, New Age International Publishes, New Delhi.
3. Dileep S. Chouha, Paresh Vyas and Vimlesh Soni. Studies in Numerical Analysis, Jaipur Publishing House, Jaipur.
4. M.K. Jain, S.R.K. Iyengar and R.K. Jain. Numerical Methods for Scientific and Engineering computation, New Age International (P) Ltd, New Delhi.

ECE 522 Telecommunication Switching & Networks

	L	T	P
Credits	2	0	1
Hours	2	0	2

Principles of circuit switching & signaling schemes, space time & space time division switching, single stage & multi stage switching network. Traffic engineering and teletraffic theory. Markov processes representing traffic, calculation of blocking probability.

Modeling and analysis of important media access control protocols: ALOHA, slotted ALOHA, CSMA, CSMA/CD.

LAN: ethernet, token ring, FDDI.B-ISDN architecture, B-ISDN protocols, ATM traffic & congestion control, signaling, routing and addressing, internetworking: switches, bridges, routers,gateways. ATM switching.

Practicals: Based on theory.

Text /References

1. Vishwanathan. Telecom Switching, PHI.
2. Flood F.E. Telecommunication Networks, Pearson Publications.

ECE 524 Advance VLSI Design

	L	T	P
Credits	2	0	1
Hours	2	0	2

Introduction to VLSI design – motiviation for IC design, IC design process, design abstraction levels, CAD tools, elements of system specification and design.

Combinational logic design, logic minimization, synchronous sequential logic design. Finite state machines, Mealy and Moore models, designing with programmable logic devices ROM, PLA, PAL, PLD.

A synchronous sequential logic- analysis procedure, state minimization, state assignment, static and dynamic hazards.

Introduction to VHDL – basic concepts in VHDL, language features, types of VHDL description – structural, data flow and behavioral descriptions of hardware, combinational and sequential design examples using VHDL. Features and internal structure of CPLDs, FPGAs, designing with CPLDs and FPGAs.

Introduction to IC floor planning and testing, design for testability, combinational logic testing, sequential logic testing, ATPG, boundary scan, built in self test. Design examples and case studies.

Practicals: Based on theory.

Text /References

1. Zainalabedin Navabi. VHDL: Analysis and Modeling of digital Systems, Mc Graw Hill.
2. Bhaskar. VHDL Prniter, PHI.
3. Donald D. Givone. Digital Principles and Design, Tata McGraw Hill.
4. M.M. Mano. Digital Design, Pearson Education.
5. John.F.Wekerly. Digital Design: Principles and Practice, Pearson Education.
6. Wayne Wolf. Modern VLSI design, Pearson Education.
7. Daniel D. Gajski, Frank Vahid, Sanjiv Narayan and Jie Gong. Specification and Design of Embedded Systems, Prentice Hall.

CSE 531 Advance Operating Systems

	L	T	P
Credits	2	0	1
Hours	2	0	2

Operating system introduction and structure, processes, threads, interprocess communication. cpu scheduling**:** Scheduling algorithm, multiprocess and realtime process scheduling, algorithm evaluation. Process synchronizations: semaphores, critical regions and monitors.

Distributed OS: architecture of distributed Systems, issues in DOS, client-server computing, message-passing, remote procedure call (RPC), limitations of DS, absence of shared memory and global clock, lamport's Logical clocks, vector clocks, causal ordering of messages.

Distributed mutual exclusion and deadlock: mutual exclusion algorithms, token-based and non-token-based algorithms, deadlock models and algorithms, deadlock detection and prevention.

Distributed file systems and shared memory: architecture of distributed file systems, design issues, replication algorithms, cache coherence.

Distributed scheduling: motivation and issues, load distribution, balancing and sharing algorithms, load distribution algorithms, load scheduler, task migration.

Failure recovery and fault tolerance: introduction and basic concepts, classification of failures, backward and forward recovery, check pointing and recovery, issues in fault tolerance, commit and voting protocols.

Real-time OS: characteristics of real time OS, hard versus soft real-time systems, real-time communications, real-time scheduling, case study: windows CE, palm OS.

Practicals: Based on theory.

Text/References

1. M. Singhal & N.G. Shivaratri. Advanced Concepts in Operating Systems, TMH.
2. A. S. Tanenbaum. Modern Operating System, PHI.
3. W. Stallings. Operating Systems, PHI.

CSE 532 Computer Graphics

	L	T	P
Credits	3	0	0
Hours	3	0	0

Computer graphics and its application areas, display devices, raster scan, random scan, color monitor, display file, frame buffer, 3-D display technique, input devices, hard copy devices.

Points, lines, plane and coordinate, character vector, circle generation algorithm, antialiasing techniques, representation of polygons, Interfacing and filling polygon, 2-D transformation, translation, rotation, scanning, shearing, reflection, composite transformation, raster transformations.

Windows, multiple windowing, view port, viewing transformation, clipping algorithm for points, line using Sutherland and Cohen, polygon, text clipping. Segment and segment operations. Interactive graphics, user dialogue, input modes, interactive picture construction techniques, curves and curved surface, interpolation and approximation curve, continuity of curve.

Concept of 3-D, representation of 3-D object, 3-D transformation, translation, rotation, reflection, scaling. Parallel perspective, isometric projections. 3-D clipping sutherland and Cohen algorithm. Hidden lines and surface removal techniques. Back face, z-buffer, painter algorithm.

Text/References

1. D. Hearn and M.P. Baker. Computer Graphics: C Version, Pearson Education.
2. James D. Foley, Andries Van Dam,Steven K. Feiner and John F. Hughes. Interactive Computer Graphics, Addison Wesley.

CSE 533 Data Mining Technology

	L	T	P
Credits	2	0	1
Hours	2	0	2

Data warehousing, OLAP and data mining, classification of data mining techniques, discovery and analysis of patterns, trends and deviations. data ware housing schema: star schema, snowflake schema, and fact constellation schema, data warehouse architecture, data marts, OLAP operations in the multidimensional data model, types of OLAP servers.

Data preprocessing: data cleaning, data integration and transformation, data Reduction. Data mining architecture, knowledge discovery in databases.

Data mining models: classification and prediction, parametric and non-parametric approaches. Classification based on association rules and decision tree models. Advanced classification based on neural networks, genetic algorithms, and fuzzy systems.

Cluster analysis: hierarchical models, model based clustering methods, outlier analysis.

Practicals: Based on theory.

Text/References

1. Inmon W.H. Building the Data Warehouse, John Wiley & Sons Inc.
2. Jiawei Han and Micheline Kamber, Data Mining Concepts and Techniques, San Francisco: Morgan Kaufmann Publishers, An Imprint of Elsevier.

CSE 534 Machine Learning

	L	T	P
Credits	3	0	0
Hours	3	0	0

The concept learning task, general-to-specific ordering of hypotheses, version spaces, inductive bias, decision tree learning. Rule Learning: propositional and first-order, over-fitting, cross-validation.

Experimental evaluation of learning algorithms instance-based learning: k-nearest neighbor algorithm, radial basis functions. case-based learning, computational learning theory: probably approximately correct (PAC) learning. sample complexity, computational complexity of training. Vapnik-chervonenkis dimension.

Minimum description length principle, bayesian networks, inference in bayesian networks.

Bayes net structure learning unlabelled data: em, preventing overfitting, cotraining gaussian mixture models, k-means and hierarchical clustering, clustering and unsupervised learning, hidden markov models, reinforcement learning. support vector machines ensemble learning: boosting, bagging.

Text/References

1. Tom. M. Mitcheli. Machine Learning, McGraw-Hill Publishing Company Ltd.
2. Ethem ALPAYDIN**.** Introduction to Machine Learning**,** The MIT Press.

CSE 535 Digital Watermarking and Steganalysis

	L	T	P
Credits	2	0	1
Hours	2	0	2

Digital watermarking, digital steganography, differences between watermarking and steganography**.** watermarking applications, techniques, models, detection techniques, visible and invisible watermarks. Robust watermarking and watermark security attacks.

Spatial-domain watermarking, substitution watermarking in the spatial domain, additive watermarking in the spatial domain, frequency-domain watermarking, substitution watermarking in the frequency domain, multiplicative watermarking in the frequency domain, watermarking based on vector quantization, the rounding error problem, the fragile watermark, the block-based fragile watermark, weaknesses of the block-based fragile watermark, the hierarchical block-based fragile watermark, the robust watermark, the redundant embedding approach, the spread spectrum approach.

Types of steganography, technical steganography, linguistic steganography, digital steganography, applications of steganography, cover communication, one-time pad communication, embedding security and imperceptibility. Steganography techniques: least bit, DCT, spread spectrum. Audio seganography.

Practicals: Based on theory.

Text/References

1. Ingemar Cox, Matthew Miller, Jeffrey Bloom, and Jessica Fridrich. Digital Watermarking and Steganography, (The Morgan Kaufmann Series in Multimedia Information and Systems).
2. Frank Y. Shih. Digital Watermarking and Steganography: Fundamentals and Techniques, CRC Press.

CSE 611 Wireless Network Technologies

	L	T	P
Credits	2	0	1
Hours	2	0	2

Development of wireless networking, wireless network logical architecture: OSI network model, network layer, data link layer and physical layer technologies. Wireless network physical architecture: wireless network topologies, wireless LAN, PAN and MAN devices.

Wireless communication: the RF spectrum, spread spectrum transmission, wireless multiplexing and multiple access techniques, digital modulation technique, RF signal propagation and reception, ultra wideband radio and MIMO radio.

Wireless LAN standards: 802.11 WLAN standards, 802.11 MAC layer, 802.11 PHY layer, 802.11 enhancements, other WLAN standards.

Wireless LAN security: hacking threat, WLAN security, WEP – wired equivalent privacy encryption, Wi-Fi protected access – WPA, IEEE 802.11i and WPA2, WLAN security measures, wireless hotspot security, VoWLAN and VoIP security.

Wireless PAN standards: bluetooth (IEEE 802.15.1), wireless USB, ZigBee (IEEE 802.15.4), IrDA. Wireless MAN standards: 802.16 wireless MAN standards and metropolitan area mesh networks. IEEE 802.20 and IEEE 802.22. Mobility in networks: mobile IP and related issues like route optimization, handoff, and security. Leading edge wireless networking technologies: wireless mesh network routing, network independent roaming, gigabit wireless LANs.

Practicals: Based on theory.

Text/References

1. Steve Rackley. Wireless Networking Technology from Principles to Successful Implementation, Elsevier.
2. William Stallings. Wireless Communication and Networks, Pearson Education.
3. Dharm Singh. A practical Approach towards Computer Networking, Himanshu Publication, New Delhi.

CSE 612 Real Time Computing

	L	T	P
Credits	3	0	0
Hours	3	0	0

Structure of a real-time system, characterization of real-time systems and tasks, performance measures. task assignment and scheduling: uniprocessor scheduling algorithms, task assignment, mode changes, fault tolerant scheduling.

Real-time communication: network topologies and architecture issues, protocols, contention-based, token-based, polled bus, fault tolerant routing.

Real-time databases: transaction priorities and aborts, concurrency control issues, scheduling algorithms, two-phase approach to improve predictability.

Programming languages and tools: hierarchical decomposition, run-time error handling, overloading, timing specification, recent trends and developments.

Text/References

1. C.M. Krishna and K.G. Shin. Real-Time Systems, McGraw Hill.
2. Jane W.S.Liu. Real Time Systems, Pearson Edition.

CSE 613 Grid Computing

	L	T	P
Credits	3	0	0
Hours	3	0	0

Grid computing and its benefits, virtual organizations, grid architecture and its relationship to other distributed technologies, grid application areas, OGSA, OGSI, semantic grids.

Building blocks for grid systems: XML, SOAP, UDDI, service oriented architecture, web services, web services architecture, WSRF, relationship between grid and web services, grid and web services invocation.

Data Management: data management in GT4, data movement: Grid FTP, RFT, data replication: RLS, Higher level data services.

Resource management and scheduling: resource management concepts, generalized resource management framework, grid resource management systems, scheduling in grids, qos, introduction to gram.

Security: security issues in grids, authentication issues, trust and privacy related issues, authorization issues, grid security frameworks, standards, web services security specifications.

Monitoring and discovery services**:** index services, resource discovery, UDDI, introduction to MDS in GT4.

Text/References

1. Joshy Joseph and Craig Fellenstein. Grid Computing, Pearson Education.
2. Bart Jacob, Michael Brown, Kentaro Fukul and Nihar Trivedi. Introduction to Grid Computing, IBM Red Books.
3. Ian Foster and Carl Kesselman. The grid 2: Blueprint for a New Computing Infrastructure, Morgan Kaufman.

CSE 614 Advanced Algorithms and Applications

	L	T	P
Credits	2	0	1
Hours	2	0	2

Dynamic programming: rod cutting, matrix chain multiplication, optimal binary search trees. Greedy algorithm: activity selection problem, elements of greedy strategy, huffman codes.

Linear programming, polynomials and the fft: representation of polynomials, DFT and FFT. String matching: native string matching algorithm, string matching with finite automata.

Number theoretic algorithms: number theoretic notions, greatest common divisor, modular arithmetic, chinese remainder theorem, modular linear equation, RSA public key cryptosystem.

Computational geometry: line segment properties, finding the convex hull, finding the closest pair of points. NP-completeness: polynomial time, polynomial time verification, np completeness and reducibility. Approximation algorithm: the vertex cover problem, travelling salesman problem, set covering problem, subset sum problem.

Practicals: Based on theory.

Text/References

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein**.** Introduction to Algorithms, PHI.
2. Alfred V Aho and John E Hopcroft. Design & Analysis of Computer Algorithms, Pearson Education India.
3. Dexter Kozen. The Design and Analysis of Algorithms, By Springer.

CSE 615 Graphics & Visualization

	L	T	P
Credits	3	0	0
Hours	3	0	0

Concept of 3-D, representation of 3-D object, 3-D transformation, translation, rotation, reflection, scaling. Parallel perspective, isometric projections. 3-D clipping sutherland and cohen algorithm. Hidden lines and surface removal techniques.

Picture analysis, modeling: 2D, 3D geometric modeling and transformations, projections, clipping, curves and fractals. Illumination models and rendering: light, ambient light, diffuse reflection, specular reflection, shading algorithms, color models, ray tracing, texture mapping.

Scientific visualization: methods of scientific exploration, data aspects and transformations, time-tested principles for good visual plots, tone mapping, matters of perception, visualizing multidimensional data, scalar data visualization, vector data visualization. Graphics user interfaces, image manipulation and storage, advanced modeling techniques.

Text/References

1. Peter Shirley, Ashikhmin Gleicher et. al., Fundamentals of Computer Graphics, A. K.Peters Ltd.
2. Hearn and Baker. Computer Graphics, PHI.
3. Van Dan Feiner, Hughes and Foley. Computer Graphics: Principles and Practice, PHI.

BS 611 Numerical Analysis of Differential Equations

	L	T	P
Credits	3	0	0
Hours	3	0	0

Numerical solution of ordinary differential equations: single step methods: taylor's series method, picard's method, euler's and euler's modified method, runge-kutta methods. Multi-step methods: milne's method, adams-moulton method, adams-bashforth method. System of simultaneous and higher order differential equations. Convergence and stability analysis.

Partial differential equations: classification of linear second order equations, finite difference methods for the solution of two-point boundary-value problems and eigenvalue problems. Elliptic, parabolic and hyperbolic partial differential equations.

Text/References

1. Babu Ram. Numerical Methods, Pearson Education India.
2. Santosh K. Gupta. Numerical Methods for Engineers, New Age International Publishes, New Delhi.
3. Dileep S. Chouha, Paresh Vyas and Vimlesh Soni. Studies in Numerical Analysis, Jaipur Publishing House, Jaipur.
4. M.K. Jain, S.R.K. Iyengar and R.K. Jain. Numerical Methods for Scientific and Engineering computation, New Age International (P) Ltd, New Delhi.

CSE 621 Advance Computer Architectures and Distributed Processing

	L	T	P
Credits	2	0	1
Hours	2	0	2

Architectural classification schemes for parallel computers, instruction and data multiplicity, serial verses parallel computers, parallelism verses pipelining, memory hierarchy.

General pipelines and reservation tables, interleaved memory organization, instruction pre-fetch and branch–handling, data buffering and business structures, internal forwarding and register tagging, hazard detection and resolution, job sequencing and collision prevention, dynamic pipelines and re configurability.

SIMD computer organization, masking and data routing mechanism inter PE communication, introduction to associative array processing. Multiprocessor architecture: loosely coupled & tightly coupled multiprocessor, processor characteristics for multiprocessing, interconnection networks, cache coherence protocols, scalable multiprocessors, clusters and network of workstations.

Distributed objects and remote method invocation, communication between distributed objects, distributed object model, design issues of RMI, remote procedure call, SUN RPC and JAVA RMI.

Practicals: Based on theory.

Text/References

1. Hwang and Briggs. Computer Architecture and Parallel Processing, Mcgraw-Hill.
2. Kai Hwang. Advanced Computer Architecture, McGraw-Hill.
3. Rajaraman. Parallel Computers Architecture and Programming.
4. D. E. Culler and J. P. Singh. Parallel Computer Architecture.
5. George Coulouris, Jean Dolimore and Tim Kindberg. Distributed Systems Concepts and Design, Addission Wesley.

CSE 622 Unix Operating System Design

	L	T	P
Credits	2	0	1
Hours	2	0	2

Operating system services, architecture of the UNIX operating system, system concept, kernel data structure, system administration.

Buffer header, structure of the buffer pool, scenarios for retrieval of a buffer, reading & writing disk blocks, advantages & disadvantages of the buffer cache, Internal representation of files : inodes, structure of a regular file, directories, conversion of a path name to an inode, super block, inode assignment to a new file, allocation of a disk blocks, other file types.

Process creation, signals, process termination, awaiting process termination invoking other programs, the user ID of a process, changing the size of a process.

Process scheduling & time: process scheduling, system calls for time clock, memory management: swapping, demand paging, a hybrid system with swapping and demand paging.

Practicals: Based on theory.

Text/References

1. Maurice J. bach. The Design of the Unix Operating System, Pearson Education.
2. Jerry Peek, Grace Todino and John Strang. Learning the Unix Operating System, A Concise Guide for the New User, O'Reilly Media.

CSE 623 Modelling and Simulation

	L	T	P
Credits	3	0	0
Hours	3	0	0

Importance of simulation and modelling, discrete-event simulation, time advance mechanisms, components and organization of discrete-event simulation, continuous simulation, random number generation methods.

Queuing models: single server queuing system, arrival and departure time and routine, event graphs of queuing model, determining the events and variables.

Distribution functions: stochastic activities, discrete probability functions, cumulative distribution function, continuous probability functions. Generation of random numbers following binomial distribution, poisson distribution, continuous distribution, normal distribution, exponential distribution, uniform distribution.

Programming: branching statements, loops, functions, additional data types, plots, arrays, inputs/outputs etc.

Text/References

1. Averill M.Law and W. david Kelton. Simulation Modeling and Analysis, Tata McGraw-Hill Publication.
2. Geoffery Gordon. System Simulation, Prentice-Hall of India.
3. D.S.Hira. System Simulation, S.Chand Publications.

CSE 624 Cloud Computing

	L	T	P
Credits	3	0	0
Hours	3	0	0

History of cloud computing, cloud architecture and storage, advantages and disadvantages of cloud computing.

Developing cloud services: web-based application, pros and cons of cloud service development, types of cloud service development, software as a service, platform as a service, web services, on-demand computing, discovering cloud services development services and tools.

Centralizing email communications, collaborating on schedules, collaborating on to-do lists, collaborating contact lists, cloud computing for the community, collaborating on group projects and events, cloud computing for the corporation.

Using cloud services: collaborating on calendars, schedules and task management, exploring online scheduling applications, exploring online planning and task management, collaborating on event management, collaborating on contact management, collaborating on project management, collaborating on word processing, collaborating on databases, storing and sharing files.

Text/References

1. Michael Miller. Cloud Computing: Web-Based Applications that change the way you work and collaborate online, Pearson Education, India.
2. Anthony T.Velte, Toby J.Velte and Robert Elsenpeter. Cloud Computing–A Practical Approach, Tata McGraw Hill Education Pvt. Ltd.
3. Haley Beard. Cloud Computing Best Practices for managing and measuring processes for on demand computing, applications and data center in the cloud with slas, Emereo Pty1.

CSE 625 Web Engineering

	L	T	P
Credits	2	0	1
Hours	2	0	2

Web applications versus conventional software, web hypermedia, web software, or web application, web development vs. software development, the need for an engineering approach, empirical assessment.

Web effort estimation: effort estimation techniques, expert opinion, algorithmic techniques, artificial intelligence techniques, measuring effort prediction power and accuracy, measuring predictive power, measuring predictive accuracy, data validation, variables and model selection, extraction of effort equation, model validation.

Web quality: different perspectives of quality, standard and quality, quality versus quality in use, quality and user standpoints, evaluating web quality using webqem, quality requirements, measurement and evaluation.

Web application testing: challenges and perspectives, testing the functional and non-functional requirements model, unit integration and system testing of a web application. Strategies: white box strategies, bloc box strategies, grey box testing strategies, user session based testing, tools for web application testing, a practical example of web application testing.

Practicals: Based on theory.

Text/References

1. Roger S.Pressman. Web Engineering, Tata Mcgraw Hill Publication.
2. Achyut S Godbole and Atul Kahate. Web Technologies, Tata McGraw Hill.
3. Gopalan N P and Akilandeswari. Web Technology: A Developers Perspective, PHI.
4. Neil Gray. Web server Programming, Wiley.
5. Chris Bates. Web Programming: Building Internet applications, Wiley.

CSE 626 Video Communications

	L	T	P
Credits	2	0	1
Hours	2	0	2

Video formation, perception, and representation video hierarchy, video encoding, DCT-based video encoding, inter-frame coding: motion estimation and compensation, scalable video encoding, temporal scalability, spatial scalability.

Internet protocol QoS: QoS fundamentals, IPv4 ToS octet, integrated service (IntServ), differentiate services (DiffServ), traffic management capabilities, and quality assessment.

Digital video compression: MPEG Frames, Group of Pictures (GOP), MPEG Video Coding Standards. Statistics of Video Traces: Compressed Video Quality Evaluation.

Video transmission over wired network, differentiated service model and wireless network. RTP (realtime transport protocol), video servers, video adaptation and transcoding. quality evaluation over wired and wireless network. Scheduling and queuing management system.

Marker scheme: legacy packet markers, marking schemes based on token bucket, single rate three color marker (srTCM) scheme, two rate three color marker (trTCM) scheme.

Compare QoS parameters of video using marker scheme. Other improved marker scheme for video communications.

Text/References

1. K.R. Rao, Z.S. Bojkovic, and D.A. Milovanovic. Multimedia Communication Systems: Techniques, Standards and Networks, Prentice Hall.

BS 621 Advanced Mathematics for Computing

	L	T	P
Credits	3	0	0
Hours	3	0	0

Matrix computations: solutions of non-homogenous system of linear equations: direct methods: matrix inversion method, gaussian elimination method, gauss-jordan method, LU decomposition method. Iterative methods: jacobi method, gauss-seidel method, the relaxation method. matrix eigenvalue problem: power method, jacobi method, given's method.

Curve fitting and approximation theory: least square principle for linear and non-linear data. Least square approximation using orthogonal polynomial. Chebyshev approximation, chebyshev polynomial, chebyshev expansions.

Fast Fourier Transform: Discrete Fourier transform, Fast Fourier transform.

Text/References

1. A.K. Gupta and S.K. Sarkar. Mathematics for Computing, Wheeler Publishing, New Delhi.
2. Babu Ram. Numerical Methods, Pearson Education India.
3. Santosh K. Gupta. Numerical Methods for Engineers, New Age International Publishes, New Delhi.
4. Dileep S. Chouha, Paresh Vyas and Vimlesh Soni. Studies in Numerical Analysis, Jaipur Publishing House, Jaipur.

Note:

1. For supporting courses course description, which are offered by other departments, refer separately syllabus of that particular department.
2. For syllabus of Non-Credit Compulsory Courses, see at the end.

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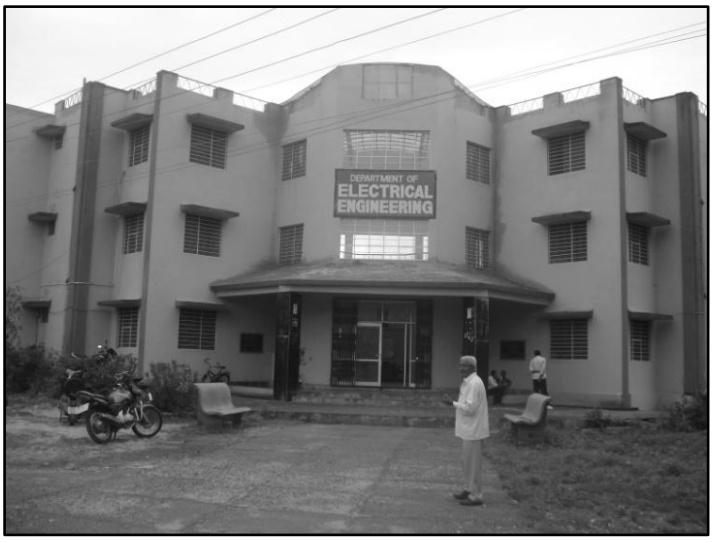
DEPARTMENT OF ELECTRICAL ENGINEERING



VISION

The Electrical Engineering Department was established with a vision of making it a centre for imparting technical education of high standards and conducting research at the cutting edge of technology to meet the current and future challenges of technological development.

MISSION

- To offer high quality graduate and post graduate programs in Electrical Engineering.
- To prepare students for professional career or higher studies.
- The department promotes excellence in teaching, research, collaborative activities and positive contributions to society

Programme Educational Objectives

1. Our graduates will be productive in the professional practice of Power Electronics related fields and higher education together with demonstrating the necessary communication, organization and teamwork skills.
2. They will obtain employment appropriate to their interests, education and will advance in their career.
3. Have scientific & technical knowledge to design, analyze, and solve emerging real world problems related to power electronics, Electric drives & related fields to bridge the divide between advanced technology and end users in the practice of power electronics.
4. Exhibit professionalism, ethical attitude, sense of responsibility in their profession
5. Adapt to current trends by engaging in lifelong learning and service to society.

Program Outcome

After the completion of the course, the students are expected to exhibit the certain abilities (a) to (h) are referred as Program Outcomes (POs):

a) Graduates will demonstrate an ability to apply knowledge of power electronics engineering & related fields, including software and hardware.
b) Graduates will demonstrate in depth knowledge of topics, which are critical to system-level design, including hardware/software tradeoffs.
c) Graduates will demonstrate the ability to function as a member of engineering and science laboratory teams, as well as on multidisciplinary design teams.
d) Graduates will demonstrate the ability to learn and work independently to identify and solve power electronics engineering related problems.
e) Graduates will demonstrate an understanding of professional and ethical responsibilities & posses effective communication skills both orally and in writing.
f) Graduates will have the confidence and potential to apply power electronics solutions in global and social contexts.
g) Graduates will show the capabilities of independent problem solving, self-learning and innovation.
h) Graduates will be truly educated and have a point of view regarding global scenario of the impact of power electronics engineering on society and will demonstrate awareness of contemporary issues at large.

Semester-wise Scheme for Post Graduate Programme in Electrical Engineering

Details of courses offered for the award of M.Tech. (Power Electronics), Electrical Engg.

S.No.	Course Title	Course No.	Credit Hours	Semester			
				I	II	III	IV
Core Courses: Total 12 credits; 2 courses in first semester (6 credits) and 1 course each in second and third semester (3 credits each) to be evaluated externally.							
1.	Power System Operation and Control	EPE 511	3 (2+1)	3	-	-	-
2.	Analysis of Power Electronic Converters	EPE 512	3 (2+1)	3	-	-	-
3.	Analysis & control of Electrical drive systems	EPE 521	3 (2+1)	-	3	-	-
4.	Utility Application of Power Electronics	EPE 531	3 (2+1)	-	-	3	-
Optional Courses: Total 15 credits; two courses in first & second semester each (6 credits in each semester) and one course in third semester (3 credits).							
1.	Advanced Semiconductor devices	EPE 513	3 (3+0)	3	-	-	-
2.	ANN and Fuzzy Logic	EPE 514	3 (3+0)	3	-	-	-
3.	Wind Energy conversion system	EPE 522	3 (3+0)	-	3	-	-
4.	Advanced Power Converters	EPE 523	3 (3+0)	-	3	-	-
5.	Modern control techniques in electrical drives	EPE 532	3 (3+0)	-	-	3	-
Minor & Supporting Courses: Total 9 credits; one course in first, second and third semester each (3 credits in each semester).							
1.	System Theory	EPE 515	3 (3+0)	3	-	-	-
2.	Modeling & Analysis of Electrical machine	EPE 516	3 (3+0)	3	-	-	-
3.	CAD/ CAM	MED 518	3 (3+0)	3	-	-	-
4.	Advance Programming with C++	CSE 511	3 (2+1)	3	-	-	-
5.	Energy Audit and Management	RES 515	3 (2+1)	3	-	-	-
6.	Computer aided power system analysis	EPE524	3 (3+0)	-	3	-	-
7.	Methods of Numerical Analysis	BS 521	3 (3+0)	-	3	-	-
8.	Alternate Fuels and Applications	RES 524	3 (3+0)	-	3	-	-
9.	Design and Analysis of Renewable Energy Conversion Systems	RES 522	3 (3+0)	-	3	-	-
10.	High Voltage dc Transmission system	EPE 533	3 (3+0)	-	-	3	-
11.	Industrial Automation and Control	EPE534	3 (3+0)	-	-	3	-
Others							
	Courses; {(0+1) or (1+0)} Non Credit (NC); PGS Series	PGS501/ 502...	1	NC	NC	-	-
	Seminar (0+1)	EPE 535	1	-	-	1	-
	Comprehensive	EPE 540	NC	-	-	NC	-
	Thesis*	EPE 541	20	-	-	-	20
	Total Credit to be offered (57)			**15**	**12**	**10**	**20**

COURSE SUMMARY

Courses	No. of Courses					Credit Hours
	Semester					
	I	II	III	IV	Total	
Core	2	1	1	-	4	12
Optional	2	2	1	-	5	15
Minor & Supporting	1	1	1	-	3	9
Seminar	-	-	1	-	1	1
Comprehensive	-	-	-	1	1	Non Credit (graded as satisfactory/non satisfactory)
Research (Thesis)	-	-	-	1	1	20* (graded as satisfactory/ non satisfactory)
Compulsory Courses (PGS Series)	1	1	-	-	2	Non Credit
Total	**6**	**5**	**4**	**2**	**17**	**57**

*Research (Thesis) credit load is not counted in calculation of final OGPA.

Semester-wise Scheme for Ph.D. Programme in Electrical Engineering

Details of courses offered for the award of Ph.D. in Electrical Engineering

S.No.	Title	Course No.	Cr. Hr.	Semester			
				I	II	III	IV-VI
Core Courses: Total 6 credits (3 credits in each semester); one course in first semester and one course in second semester to be evaluated externally.							
1.	Selected topics in power electronics	EPE 611	3 (2+1)	3	-	-	-
2.	Electricity energy marketing	EPE 612	3 (2+1)	3	-	-	-
3.	Selected Topics in Power System and control	EPE 621	3 (2+1)	-	3	-	-
4.	Utility Applications of Power Electronics	EPE 622	3 (2+1)	-	3	-	-
Optional Courses: Total 12 credits (6 credits in each semester); two course in first and second semester each.							
1.	High Voltage dc Transmission system	EPE 613	3 (3+0)	3	-	-	-
2.	Flexible AC transmission system	EPE 614	3 (3+0)	3	-	-	-
3.	ANN and Fuzzy Logic	EPE615	3 (3+0)	3	-	-	-
4.	Analysis & control of Electrical drive systems	EPE 623	3 (3+0)	-	3	-	-
5.	Wind Energy conversion system	EPE 624	3 (3+0)	-	3	-	-
Minor & Supporting Courses: Total 9 credits; two courses in first semester (6 credits) and one course in second semester (3 credits).							
1.	Analysis of Power Electronic Converters	EPE 616	3 (3+0)	3	-	-	-
2.	Modeling & Analysis of Electrical machine	EPE 617	3 (3+0)	3	-	-	-
3.	Power system optimization	EPE 618	3 (3+0)	3	-	-	-
4.	Power electronics application for renewable energy	EPE 625	3 (3+0)	-	3	-	-
5.	Power Quality in distributed system	EPE 626	3 (3+0)	-	3	-	-
6.	Power system reliability	EPE 627	3 (3+0)	-	3	-	-
Others							
	Compulsory Courses+; {(0+1) or (1+0)} Non Credit (NC); PGS Series	PGS501/502/...	1	NC	NC		
	Seminar	EPE 691/ 692	1 (0+1)	1	1	-	-
	Preliminary	EPE 632	NC			NC	
	Research (Thesis). Thesis minimum duration 4 semesters	EPE 633	45	-	-	-	45
	Total credits to be offered		**74**	**16**	**13**	**-**	**45**

Note: A Ph.D. student must take two 600 series core courses. A student may choose optional/minor & supporting courses of 500 series courses if not studied during Masters Programme as per ICAR guidelines.

\+ Exempted for those who have cleared these in Master's Programme (permission to be sought from the Dean, CTAE).

COURSE SUMMARY

Courses	No. of Courses							Credit Hours
	Semester							
	I	II	III	IV	V	VI	Total	
Core	1	1	-	-	-	-	2	6
Optional	2	2	-	-	-	-	4	12
Minor & Supporting	2	1	-	-	-	-	3	9
Seminar	1	1	-	-	-	-	2	2
Preliminary	-	-	1	-	-	-	1	Non Credit (graded as satisfactory/ non satisfactory)
Research (Thesis)	-	-	-	-	-	1	1	45* (graded as satisfactory/ non satisfactory)
Compulsory Courses** (PGS Series)	1	1	-	-	-		2	Non Credit
Total	**7**	**6**	**1**	**-**	**-**	**1**	**15**	**74**

*Research (Thesis) credit load is not counted in calculation of final OGPA.

**Exempted for those who have cleared these in Master's Programme.

SYLLABUS

ELECTRICAL ENGINEERING

(a) M.Tech. Programme (Power Electronics)

EPE 511 Power System Operations and Control

	L	T	P
Credit	2	0	1
Hours	2	0	2

CO1: Proficiency in voltage & frequency control of modern power system

CO2: Ability to realize the modern power system with FACTS devices

CO3: Capability to contrive Load Dispatch functions

CO4: Competence in power flow analysis

Introduction (Characteristics of Modern Power Systems): Physical Structure, Operation and Control Functions and Hierarchies, Design and Operating Criteria.

Equipment and Stability Constraints, Capabilities and Constraints of Generators/Exciters/Turbines/ Network Elements (Lines, Transformers etc.) Constraints of Energy Supply Systems, Load Characteristics Introduction to Angle/Voltage Instability phenomena Stability Constraints.

Frequency and Voltage Control: Primary Control of Frequency-Governors

Secondary Control of Frequency- AGC.

Voltage control: Automatic Voltage Regulators (generators), Shun Compensation, SVC.

Introduction to Power Flow Control- HVDC, FACTS Load Curves Unit Commitment Introduction to the use of Optimization Method in power systems.

Load Dispatch Centre Functions: Contingency Analysis

Preventive, Emergency and Restorative Control.

Reference Books

1. Electrical Energy Systems Theory - by O.I.Elgerd, Tata McGraw-Hill Publishing Company Ltd, 2nd edition.
2. Power System Analysis by HadiSaadat - Tata McGraw Hill Publications.
3. Power Generation, Operation and Control - by A.J.Wood and B.F.Wollenberg,John wiley& sons Inc. 1984.
4. Modern Power System Analysis - by I.J.Nagrath&D.P.Kothari, Tata McGraw-Hill Publishing Company ltd, 2nd edition.
5. Power System Stability and Control by Prabha Kundur, McGraw-Hill Publishing Company Ltd.

EPE 512 Analysis of Power Electronic Converters

	L	T	P
Credit	2	0	1
Hours	2	0	2

CO1: Competency in function of various power electronics devices.

CO2: Skill of analysing power electronic devices.

CO3: Know-how of advance Power electronics converter.

CO4: Fitness in mitigating converter harmonics.

Phase Controlled Converters: Performance measures of single and three-phase converters with discontinuous load current for R, RL and RLE loads. Effect of source inductance for single and three phase converters.

Chopper: Review of choppers configurations, Steady state analysis of type A Chopper-Minimum and Maximum Currents, Ripple and average load current. Commutation in Chopper Circuits.

Inverters: Performance parameters, Principle of Operation, Single-phase bridge inverters, Three phase bridge Inverters: 180 and 120 degree of conduction, Current source inverters , voltage control of three phase inverters Sinusoidal PWM, Third Harmonic PWM, 60 degree PWM and Space Vector Modulation. Harmonic reductions AC Voltage Controllers: Principle of On-Off Control, Principle of Phase control, Single Phase Bi-directional Controllers with Resistive Loads, Single Phase Controllers with Inductive Loads, Three Phase full wave AC controllers, AC Voltage Controller with PWM Control.

Cyclo-converters: Single phase and three phase Cyclo-converters. Reduction in Output Harmonics, Matrix Converter.

Text and Reference books

1. Advanced Power electronics - Vinod Kumar, R. R. Joshi, R.C. Bansal, Agarwal and Sharma, Vardhan Publication and distributors, Jaipur, India
2. Power electronics - N. Mohan, John Wiley student edition, Singapore
3. Power electronics : circuits, drives and applications - H Rashid, , Pearson, India

EPE 513 Advanced Semiconductor Devices

	L	T	P
Credit	2	0	1
Hours	2	0	2

CO1: Proficiency utilizing harnessing typical parameters of power semiconductor devices.

CO2: Capability in testing & harnessing typical characteristics of power semiconductor devices.

CO3: Competency in Triggering & Protective mechanism of semiconductor devices.

CO4: Know-how & aptitude towards future Trends in Power Devices.

Structure and Construction, Working and operations, Switching and Static Characteristics, Ratings.

Triggering Circuits, Protection Circuits, Commutation Circuits, PSPICE Models, Testing, Gate Drive Requirements and Applications of various Power Switching Devices, i.e. SCR, GTO, MOSFETS, BJT, IGBT, MCTs, and Static Induction Devices .

Trigger Techniques, Optical Isolators, Protection Circuits, Isolation Transformers, Future Trends in Power Devices, Comparison Testing of Switches, General Power Semiconductor Switch Requirements.

Text and Reference books

1. Power electronics - N. Mohan, John Wiley student edition, Singapore.
2. Power electronics and A C Drives - B. K. Bose, Pearson, India.
3. Power electronics : circuits, drives and applications - H Rashid, Pearson, India.
4. Power electronics Devices - P. C. Sen, TMH, India.

EPE 514 ANN and Fuzzy Logic

	L	T	P
Credit	2	0	1
Hours	2	0	2

CO1: Ability to contrive optimum NN architecture for specific engineering problem.

CO2: Compentency in applying NN technology in control problems.

CO3: Skill in framing fuzzy rules & employing fuzzy technique in solving engineering problems.

CO4: Dexterity in contriving neuro –fuzzy based solutions

Neural Network: Introduction-biological neurons and their artificial models-learning, adaptation and neural network's learning rules types of neural networks-single layer, multiplayer-feed forward, feedback networks; back propagation learning and training-Hopfield network.

Neural Networks in Control:Neural network for non-linear systems-schemes of neuro control-system identification forward model and inverse model-indirect learning neural network control applications-case studies.

Neural Network in Control: Structure of fuzzy logic controller-fuzzification models-data base-rule base-inference engine defuzzification module. Non-linear fuzzy control-PID like FLC-Sliding mode FLC - Surgeno FLC-adaptive fuzzy control-fuzzy control applications-case studies. Analysis of Neural Networks:Analysis of Neural Network for liner and non-liner systems. Analysis of neuro -fuzzy systems. Application of neural networks

Fuzzy Logic:Fuzzy sets-fuzzy operation-fuzzy arithmetic-fuzzy relations-fuzzy relational equationsfuzzy measure-fuzzy functions-approximate reasoning-fuzzy propositions-fuzzy quantifiers-if-then rules. Adaptive Fuzzy control: Introduction, design & performance evaluation, performance monitor, main approaches to design. FKBC design parameters: Structure of FKBC fuzzification and defuzzification module, rule based choice of variable and contents of rules, derivation of rule data based, choice of membership function and scaling factors,

Text Books/References

1. Introduction of artificial neural systems - J.M.ZURADA, Jaico publication House 1997

2. Neural networks: comprehensive foundation - S.IIAYKIN McMillian College Publishing company inc. 1994

3. Neuro control and its application - S.OMATU, M.KHALID, R.YUSOF. Spring Verlag London Ltd. 1996.

4. An introduction to fuzzy control - D.DRIANKOV, H. HELLENDOORN and M REINFRANK Narosa Publication House, 2nd reprint 1997.

5. Neural Network Design, - Hagan, Demuth Deak Thomson Learning.

6. Neuro-fuzzy and soft computing, PHI publication.

7. Fuzzy logic : Intelligence control and Information, - John Yen Pearson publication.

EPE 515 System Theory

	L	T	P
Credit	3	0	0
Hours	0	0	0

CO1: Know-How of Modern control theory concepts & methods.

CO2: Capability of state space modelling.

CO3: Competency in anylysing non-linear system.

CO4: Skill of harnessing advanced stability criterion.

State Space Analysis: Concept of state, state space representation of systems, phase variable form, canonical variable form, physical variable form, Diagonalization, relationship between state equation and transfer function, solution of state equation, concept of controllability and observability, eigen values and eigen vector.

Sampled Data System: importance of sampling, mathematical analysis of sampling, spectrum analysis of sampling process, Shanon's Theorem, signal reconstruction, hold circuit, Z transform, inverse Z transform, difference equation, pulse transfer function, state variable representation of sampled data system, solution of discrete state equation.

Non Linear system: characteristic of nonlinear system, type of Non linearity, jump resonance, limit cycle, describing function method of analysis.

Liapunov Stability Criteria: Introduction, stability definitions and theorems, Liapunov function for linear system.

References / Suggested Text Books

1. Nagrath& M. Gopal, "Control System Engineering", New Age International Publications, 2009.

2. B. S. Manke, "Control System Design" Khanna Publications, 2011.

3. Ogata, "Modern Control Engineering" Pearson Education, 2008.

4. D. Roy Choudhary, "Modern Control Engineering", DhanpatRai& Sons Publication, 2008.

EPE 516 Modeling & Analysis of Electrical Machine

	L	T	P
Credit	3	0	0
Hours	0	0	0

CO1: Know-How of Electromagnetic energy conversion techniques.

CO2: Competency in modelling asynchronous & synchronous induction machine.

CO3: Ability to analyse steady state & dynamic operation of induction machine.

CO4: Capability in contriving drive operation as per the industry requirements.

Basic principle of Electrical Machines: Introduction, Magnetically coupled circuit, Electromagnetic energy conversion, machine winding and air gap EMF, winding inductance and voltage equations, equation of transformation, Reference-Frame Theory.

Fundamental of Electrical Drives: Introduction, Choice of Electrical Drives, Dynamics of Electrical Drives, Concept of Multi-quadrant operation, Components of load torques, Selection of motor power rating, Speed torque, speed control, Starting, Braking.

Symmetrical Induction Machines: Introduction, voltage and torque equations in machine variables, voltage and torque equations in arbitrary reference frame, Analysis of steady state and dynamic operation.

Synchronous Machines: Introduction, voltage and torque equations in machine variables, voltage equations in rotor reference frame, Analysis of steady state and dynamic operation.

References / Suggested Text Books

1. P. C. Krause, OregWasynczuk, Scott D. SudhoffP.C.Krause, OregWasynczuk, Scott D. Sudhoff, “Analysis of Electric Machinery and drive systems”, IEEE Press, 2002.
2. P. S. Bhimbra, “Generalised Theory of Electrical Machines”, Khanna Publications 2013.
3. G. K. Dubey, “Fundamentals of Electrical Drives” Narosa, 2009.
4. G. K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall international, New Jersey, 1989.
5. R. Krishnan, “Electric Motor Drives Modeling, Analysis and Control” PHI-India, 2005.

EPE 521 Analysis & Control of Electrical Drive Systems

	L	T	P
Credit	2	0	1
Hours	2	0	2

CO1: Competency in developing Dynamic model of drive system.

CO2: Fitnees in solving typical drive issues.

CO3: Ability in control strategy of cycloconverter based Drives.

CO4: Skill in Transient analysis of drive system.

DYNAMICS OF ELECTRIC DRIVES: Dynamic conditions of a drive system, Energy loss in transient operations, steady state stability, load equalization, close loop configurations of drives.

DC DRIVES: Basics of DC machines, Speed torque curves, torque and power limitation in armature voltage and field control, Starting, Braking-Regenerative Braking, dynamic braking and plugging, Transient analysis of separately excited motor with armature and field control, Energy losses during transient operation, Speed Control-Controlled Rectifier fed DC drives, Dual-converter control of DC drive, Chopper Controlled DC drives

INDUCTION MOTOR DRIVES: Basics of Induction Machines, Starting, Braking-Regenerative braking, plugging and dynamic braking, Transient analysis, Calculation of energy losses, Speed Control-Stator voltage control, variable frequency control from voltage source, Voltage Source Inverter (VSI) Control, Variable frequency control from current source, Current Source Inverter (CSI) Control, Cyclo-converter Control, Static rotor resistance control, Slip Power Recovery- Stator Scherbius drive, Static Kramer drive.

SYNCHRONOUS MOTOR DRIVE: Control of Synchronous Motor-Separately Controlled and VSI fed Self-Controlled Synchronous Motor Drives. Dynamic and Regenerative Braking of Synchronous Motor with VSI, Control of Synchronous Motor Using Current Source Inverter (CSI), Speed control - variable frequency control, Cycloconverters control.

Text and Reference books

1. Power electronics and A C Drives - B K Bose, Pearson, India.
2. Power electronics: circuits, drives and applications - H Rashid, Pearson, India.
3. A C Drives - J M D Murphy, John Wiley student edition.

EPE 522 Wind Energy Conversion System

	L	T	P
Credit	3	0	0
Hours	0	0	0

CO1: Aptitude & proficiency in grid interconnection requirements for wind farms.

CO2: Ability of integrating power electronics device with Renewable Energy Sources.

CO3 : Know-how of Wind Power Control.

CO4: Skill in developing MPPT techniques.

Modern power electronics technology for the integration of renewable energy sources, various topologies of power electronics converters (PECs), grid interconnection requirements for wind farms, integration issues, operational issues, grid integration issues in India, challenges for grid integration, wind power integration standards, super grid strategy, IEC standards for wind turbines

Power electronics in wind power plants, power electronics converters (PEC) classifications, Applications of PEC in wind power plants, Modern PEC in wind power plants.

Maximum power point tracking-Methods, Generators and speed control used in wind power energy, Wind Power Control

Text Books/References

1. Wind power plants and projects developments, Joshua Earnest and T Wizelius, PHI, New Delhi, 2011.
2. Handbook of renewable energy technology, World Scientific, Siongapore, 2011.

EPE 523 Advanced Power Converters

	L	T	P
Credit	3	0	0
Hours	0	0	0

CO1: Capability in designing isolated converters.

CO2: Ability to dynamic analysis of power Converters.

CO3: Competency in operation of resonant converter.

CO4: Know-how of multilevel converter.

Single-Switch Isolated Converters: Requirement for isolation in the switch-mode converters, transformer connection, Forward and flyback converters, power circuit and steady-state analysis. Push-Pull Converters- Power circuit and steady-state analysis, utilization of magnetic circuits in single switch and push-pull topologies.

Dynamic Analysis of DC-DC Converters: Formulation of dynamic equation of buck and boost converters, averaged circuit models, linearization technique, small-signal model and converter transfer functions.

Resonant Converters: Classification of Resonant converters-Basic resonant circuits- Series resonant circuit-parallel resonant circuits- Resonant switches. Concept of Zero voltage switching, principle of operation, analysis of M-type and L-type Buck or boost Converters. Concept of Zero current switching, principle of operation, analysis of M-type and L-type Buck or boost Converters

Multilevel Converters: Basic concept, classifications, working principle, applications

Text Books/References

1. Switched Mode Power Conversion, Course Notes, CCE, IISc, 2004.
2. Issa Batarseh, ‘Power Electronic Circuits’, John Wiley, 2004.
3. Philip T Krein,’ Elements of Power Electronics ‘,Oxford Press.
4. Fundamentals of Power Electronics - Robert Erickson and Dragon Maksivimovic,
5. Springer Publications. Power Electronics-IssaBatarseh- John Wiely
6. Elements of Power Electronics - Philip T.Krein - Oxford University Press

EPE 524 Computer Aided Power System Analysis

	L	T	P
Credit	3	0	0
Hours	0	0	0

CO1: Ability to develop Matlab Programs for engineering Systems.

CO2: Competency in Harmonic analysis, FFT, DFT using MATLAB.

CO3: Know-how of applying ANN, fuzzy Logic & DSP toolbox for solving problems.

CO4: Ability in harnessing numerical solutions.

MATLAB: Introduction, functions, string, array, operator, entering, matrices control flow, M-files, graphics, two dimension, mesh, surface, contour plot, graphics of polar system, application of MATLAB numerical techniques, curve fitting, polynomial. Application of various toolboxes viz. Control system toolbox, Neural Network toolbox, Fuzzy logic toolbox, signal processing toolbox. Applied Numerical analysis: Roots of polynomial equations, Newton Raphson method for non linear equations. Numerical differentiation & integration: - Newton-Cotes Gaussian type quadrature methods. Fourier series and Fourier transform. FFT, DFT concepts & their applications in harmonic analysis.

Text and Reference Books

1. MATLAB – Rudrapratap.
2. Numerical analysis – Shastry.

EPE 531 Utility Application of Power Electronics

	L	T	P
Credit	2	0	1
Hours	2	0	2

CO1: Know-how of equipment of converter station.

CO2: Ability to develop Mathematical model of each technique.

CO3: Competency in designing FACTS controllers.

CO4: Capability to design Active power filters.

Overview of Power Converters in Static Excitation Systems.

HVDC Transmission: Basic scheme and equipment of converter station, 12 - pulse converter, converter unit, converter operation, fitters, reactive power source, ground return and ground electrode, Converter Circuits: Rectification and inversion, effect of reactance, six pulse and twelve pulse converter circuits; Multi Terminal DC.

(MTDC) Systems: Types of MTDC systems, Comparison of series and parallel MTDC systems, Control and protection of MTDC systems, Application of MTDC systems.

FACTS: Static shunt compensators: Objectives, Methods of controllable VAR generation, Static VAR compensators SVC, and STATCOM, Comparison between SVC, TATCOM and static VAR systems; Static series compensators: Objectives, Variable impedance type, Switching converter type, System control and comparison, Combined compensators: PFC, IPFC, Generalized and multi functional FACTS controllers.

Active power filters: Types, shunt active filters, Series active filters.

Text and Reference books

1. Padiyar.K.R., hvdc transmission systems, new age international, 2006.
2. Mohan.N, undeland.t.m., robbins.w.p., power electronics, john wiley & sons (asia) pte. Ltd, 3rd ed., 2003.
3. Rashid.m.h(ed)., power electronics handbook, elsivier, 2001.
4. Padiyar.k.r., facts controllers in power transmission and distribution, new age international, 2007.

EPE 532 Modern Control Techniques in Electric Drives

	L	T	P
Credit	3	0	0
Hours	0	0	0

CO1: Ability to contrive vector control techniques.

CO2: Skill in developing flux weakening operation of Electric Drives.

CO3: Capability in Control of Switched Reluctance Motor Drives.

CO4: Competency in Control of BLDC Motor Drives.

Vector Control of Induction Motor: Principles of vector control, Direct vector control, derivation of indirect vector control, implementation-block diagram; estimation of flux, flux-weakening operation. Sensorless Vector Control of Induction Motor: Slip and speed estimation at low performance, rotor angle and flux linkage estimation at high performance-rotor speed estimation scheme-estimators using rotor slot harmonics, model reference adaptive systems, extended Kalamn filter, injection of auxiliary signal on salient rotor.

Control of Synchronous Motor Drives: Synchronous motor and its characteristics- Control strategies-Constant torque angle control- power factor control, constant flux control, flux-weakening operation, Load commutated inverter fed synchronous motor drive, motoring and regeneration, phasor diagrams. Control of Switched Reluctance Motor Drives: SRM Structure-Stator Excitation-techniques of sensor less operation-convertor topologies-SRM Waveforms-SRM drive design factors-Torque controlled SRM- Torque Ripple-Instantaneous Torque control -using current controllers-flux controllers. Control of BLDC Motor Drives: Principle of operation of BLDC Machine, Sensing and logic switching scheme, BLDM as Variable Speed Synchronous motor-methods of reducing Torque pulsations -Three-phase full wave Brushless dc motor -Sinusoidal type of Brushless dc motor - current controlled Brushless dc motor Servo drive.

References / Suggested Text Books

1. Electric Motor Drives Modeling, Analysis & control -R. Krishnan- Pearson Education.
2. Modern Power Electronics and AC Drives -B. K. Bose-Pearson Publications.
3. Sensorless Vector Direct Torque control -Peter Vas, Oxford University Press.
4. Modern Power Electronics and AC Drives -B. K. Bose-Pearson Publications.
5. Power Electronics control of AC motors - MD Murphy & FG Turn Bull Pergman Press -1st edition-1998.
6. Fundamentals of Electrical Drives - G.K. Dubey - Narosa Publications -1995.
7. Power Semiconductor drives- G.K. Dubey-Prentice hall.

EPE 533 High Voltage dc Transmission system

	L	T	P
Credit	3	0	0
Hours	0	0	0

CO1: Skill of HVDC conveter systems.
CO2: Know-how of operation of Power electronics in HVDC system.
CO3: Competency in designing filters & DC link control for HVDC System.
CO4: Acquaintance with MTDC system & its open challenges.

HVDC Transmission: Basic scheme and equipment of converter station, 12 - pulse converter, converter unit, converter operation, fitters, reactive power source, ground return and ground electrode, Comparison between AC and DC transmissions, Application of HVDC transmission. Converter Circuits: Rectification and inversion, effect of reactance, six pulse and twelve pulse converter circuits.

DC Link Control: Principles of DC link control, Converter control characteristics, System control hierarchy, Firing angle control, Extinction angle control, starting, stopping and power flow reversal of DC link, Power control, Parallel operation of DC link with AC transmission line; Converter faults, commutation failure, valve blocking and bypassing; Protection against over currents, over voltages; DC circuit breaker; Reactive Power Control: Reactive power requirement in steady state, Sources of reactive power and reactive power control; Power modulation and power control of HVDC lines.

Harmonic and Filters: Generation of harmonics, AC and DC side harmonics, characteristics and non-characteristics harmonics. Types of AC filters - single tuned and double tuned filters, high pass filter, DC Smoothing reactor and filters; Scheme of a HVDC converter station and components of HVDC transmission system.

Multi Terminal DC (MTDC) Systems: Types of MTDC systems, Comparison of series and parallel MTDC systems, Control and protection of MTDC systems, Application of MTDC systems.

References / Suggested Text Books

1. K.R. Padiyar : HVDC Power Transmission System, 2nd Edition, New Age International Pub. Limited.

EPE 534 Industrial Automation and Control

	L	T	P
Credit	3	0	0
Hours	0	0	0

CO1: Ability in understanding atomization in Industrial Sector.
CO2: Know-how of control mechanism utilized in Industrial Devices.
CO3: Proficiency in signal conditioning & processing in automated system.
CO4: Competency in Designing automated industrial control system.

Introduction to Industrial Automation and Control, Architecture of Industrial Automation Systems, Introduction to sensors and measurement systems, Temperature measurement, Pressure and Force measurements, Displacement and speed measurement, Flow measurement techniques, Measurement of level etc.

Signal Conditioning and Processing, Estimation of errors and Calibration.

Introduction to Process Control, Control structures and performance measures, Time and frequency domain performance measures, Design of controller, P-I-D Control, Controller Tuning, Implementation of PID Controllers, Limitations of PID controllers, Identification of dynamic models of plants.

Reference Book

1. S. Majhi, Advanced Control Theory-Relay Feedback Approach, Cengage Asia/India Pvt.Ltd, 2009.
2. A. Johnson and H. Moradi, New Identifications and Design Methods,Springer - Verlag, 2005.
3. Norman S. Nise, Control Systems Engineering, John Wiley & Sons, 2008.
4. Patranabis, Principles of Industrial Instrumentation Tata McGraw Hill Publishing Co., New Delhi, 1999.
5. R.K.Jain, Mechanical and Industrial Measurements, Khanna Publishers, Delhi 1999.
6. A.K.Sawhney, A course in Electrical and Electronic Measurement and Instrumentation - Dhanpat Rai and Sons, New Delhi, 1999.

EPE 535 Seminar

CO1: Know-how of technology trends.

CO2: Ability to analyse burning engineering issues.

CO3: Proficiency in communication skills & presentation.

CO4: Competency in devising solution/ point-of-view for the specific problem.

EPE 541 Thesis

CO1: Ability to frame the problems relating to any specific engineering systems.

CO2: Know-how of solution tools.

CO3: Proficiency in hardware implementation.

CO4: Competency in Designing system solutions & evaluation.

COMPULSORY COURSES

PGS 501 Library & Information Service

CO1: Know-how of technology trends.

CO2: Know-how of burning engineering issues.

CO3: Proficiency in communication skills & presentation

CO4: Competency in devising point-of-view for the specific problem.

PGS 502 Technical Writing and Communication Skill

CO1: Know-how of technology trends.

CO2: Ability to analyse burning engineering issues.

CO3: Proficiency in communication skills & presentation.

CO4: Competency in framing point-of-view for the specific problem.

(b) Ph.D. Programme (Electrical Engineering)

EPE 611 Selected Topics in Power Electronics

	L	T	P
Credit	2	0	1
Hours	2	0	2

CO1: Skill in Controller Design of advanced converter systems.

CO2: Know-how of Resonant Converters based solutions.

CO3: Competency in design & applications of Multilevel Converters.

CO4: Dexterity in advanced drive control like DTFC & field control strategies.

Controller Design: Review of frequency-domain analysis of linear time-invariant systems, concept of bode plot, phase and gain margins, bandwidth, controller specifications, proportional (P), proportional plus integral (PI), proportional plus integral plus integral controller (PID), selection of controller parameters.

Resonant Converters: Classification of Resonant converters-Basic resonant circuits- Series resonant circuit-parallel resonant circuits- Resonant switches. Concept of Zero voltage switching, principle of operation, analysis of M-type and L-type Buck or boost Converters. Concept of Zero current switching, principle of operation, analysis of M-type and L-type Buck or boost Converters, parallel resonant inverters, class E resonant converter, Two quadrant ZVS converter and resonant d.c. link inverter.

Multilevel Converters: Basic concept, classifications, working principle, applications.

Review of Scalar Control, Direct and Indirect Field Oriented Control, Direct Torque Control.

Text and Reference Books

1. Advanced power electronics – Gilbert, John Wiley.
2. Power electronics and A C Drives – B K Bose, Pearson, India.
3. Power electronics : circuits, drives and applications – H Rashid, Pearson, India.

EPE 612 Electricity Energy Marketing

	L	T	P
Credit	2	0	1
Hours	2	0	2

CO1: Skill of Economics in Electric Power supply in deregulated environment.

CO2: Know-how of recent trends in Electric Power Industry.

CO3: Competency in heuristic optimization techniques in Electric Power Industry.

CO4: Dexterity in Financial Transmission Rights.

Overview of the Electric Power Industry: History of the Electric Power Industry, Deregulation Overview, Vertical Integration, Market Structure in the India.

Overview of Economic Theory: Supply & Demand, Consumer Surplus & Producer Surplus, Price Taking, Profit Maximization, Monopoly, Game Theory, Equilibrium Models(Reduce), Market Power (Hockey Stick Bidding, Deck Game, Measurements of market power), Auctions, Theory of Second Best (Transmission Expansion, Carbon Tax).

Optimization: Introduction to Linear Optimization, Linear Programming (Convex sets, Primal and Dual, Proof of Optimality, Duality Theory), Mixed Integer Linear Programming, heuristic optimization methods.

Dispatch Optimization Models: Material: Economic Dispatch, Direct Current Optimal Power Flow (DCOPF), Unit Commitment. Pricing: Uniform Market Clearing Prices (MCP) vs Pay as Bid, Locational Marginal Pricing (LMPs).

Objectives, Rents, Congestion: Dual of the DCOPF, Load payment, Congestion Rent, Generation Rent.

Financial Transmission Rights: Simultaneous Feasibility Test, Revenue inadequacy.

Reference Books

Market Operations in Electric Power Systems: Forecasting, Scheduling, and Risk Management by M. Shahidehpour, Zuyi Li and Hatim Yamin, IEEE Computer Society Press (first published March 28th 2002).

EPE 613 High Voltage dc Transmission System

	L	T	P
Credit	3	0	0
Hours	3	0	0

CO1: Skill of recent trends in HVDC converter systems.

CO2: Know-how of operation of Power electronics in HVDC system.

CO3: Competency in designing filters & DC link control for HVDC System.

CO4: Acquaintance with MTDC system & its related issues.

Thyristor Valve: Thyristor device, Steady state and switching characteristics, light activated power thyristor, LED, fiber optics, valve firing, parallel and series connections of thyristors.

Converter Circuits: Rectification and inversion, effect of reactance, six pulse and twelve pulse converter circuits.

DC Link Control: Principles of DC link control, Converter control characteristics, System control hierarchy, Firing angle control, Extinction angle control, Starting, stopping and power flow reversal of DC link, Power control, Parallel operation of DC link with AC transmission line. Converter faults, commutation failure, valve blocking and bypassing. Protection against over currents, over voltages.DC circuit breakers. Reactive Power Control: Reactive power requirement in steady state, Sources of reactive power and reactive power control.

Harmonic and Filters: Generation of harmonics, AC and DC side harmonics, characteristics and non-characteristics harmonics. Types of AC filters – single tuned and double tuned filters, high pass filter, DC Smoothing reactor and filters.

Multi Terminal DC (MTDC) Systems: Types of MTDC systems, Comparison of series and parallel MTDC systems, Control and protection of MTDC systems, Application of MTDC systems.

References / Suggested Text Books

K.R. Padiyar: HVDC Power Transmission System, 2nd Edition, New Age Intl. Pvt. Ltd., 2012.

EPE 614 Flexible A.C Transmission System

	L	T	P
Credit	3	0	0
Hours	3	0	0

CO1: Ability to design & contrive Voltage-Sourced Converters.

CO2: Compentency in developing Static series & Shunt Compensators.

CO3: Skill in designing Unified Power Flow Controller (UPFC).

CO4: Dexterity in designing Static Voltage and Phase Angle Regulators.

The phenomenon of voltage collapse; the basic theory of line compensation Problems of AC transmission systems, power flow in parallel paths and meshed system, factors limiting loading capability, stability consideration. Power flow control of an ac transmission line. Basic types of facts controllers. Advantages of FACTS technology.

Voltage-Sourced Converters: Basic concept of voltage-sourced converters, single and three phase bridge converters. Introduction to power factor control. Transformer connections for 12- pulse, 24 pulse and 48 pulse operations.

Static Shunt Compensators: Midpoint and end point voltage regulation of transmission line, and stability improvement. Basic operating principle of Static Synchronous Compensators (STATCOM).Comparison between STATCOM and SVC.

Static Series Compensators: Concept of series capacitive compensation, voltage and transient stabilities, power oscillation and subsynehronous oscillation damping. Introduction to thyristor-

switched series capacitor (TSSC), thyristor controlled series capacitor (TCSC), and static synchronous series compensator-operation, characteristics and applications.

Static Voltage and Phase Angle Regulators: Voltage and phase angle regulation. Power flow control and improvement of stability by phase angle regulator. Introduction to thyristor controlled voltage and phase angle regulators (TCVR and TCPAR).(ii) Introduction to thyristor controlled braking resistor and thyristor controlled voltage limiter.

UPFC: Unified Power Flow Controller (UPFC), basic operating principles, conventional transmission control capabilities. Comparison of UPFC to series compensators and phase angle regulator. Applications of UPFC.IPFC: Interline Power Flow Controller (IPFC), basic operating principles and characteristics. Applications of IPFC.

References / Suggested Text Books

1. NarainG.Hingorani, Laszio. Gyugy.L, "Understanding FACTS Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers –Delhi 2001.
2. FACTS – Guilder.
3. FACTS – Bhatnagar / Soni.

EPE 615 ANN and Fuzzy Logic

	L	T	P
Credit	3	0	0
Hours	3	0	0

CO1: Ability to contrive optimum NN architecture for specific engineering problem.

CO2: Compentency in applying NN technology in control problems.

CO3: Skill in framing fuzzy rules & employing fuzzy technique in solving engineering problems.

CO4: Dexterity in contriving neuro –fuzzy based solutions.

Neural Network: Introduction-biological neurons and their artificial models-learning, adaptation and neural network's learning rules types of neural networks-single layer, multiplayer-feed forward, feedback networks; back propagation learning and training-Hopfield network.

Neural Networks in Control: Neural network for non-linear systems-schemes of neuro control-system identification forward model and inverse model-indirect learning neural network control applications-case studies

Neural Network in Control: Structure of fuzzy logic controller-fuzzification models-data base-rule base-inference engine defuzzification module. Non-linear fuzzy control-PID like FLC-Sliding mode FLC - Surgeno FLC-adaptive fuzzy control-fuzzy control applications-case studies.

Analysis of Neural Networks: Analysis of Neural Network for liner and non-liner systems. Analysis of neuro -fuzzy systems. Application of neural networks

Fuzzy Logic: Fuzzy sets-fuzzy operation-fuzzy arithmetic-fuzzy relations-fuzzy relational equations-fuzzy measure-fuzzy functions-approximate reasoning-fuzzy propositions-fuzzy quantifiers-if-then rules. Adaptive Fuzzy control: Introduction, design & performance evaluation, performance

monitor, main approaches to design. FKBC design parameters: Structure of FKBC fuzzification and defuzzification module, rule based choice of variable and contents of rules, derivation of rule data based, choice of membership function and scaling factors,

Text Books/References

1. Introduction of artificial neural systems - J.M.ZURADA, Jaico publication House 1997.
2. Neural networks: comprehensive foundation - S.IIAYKIN McMillian College Publishing company inc. 1994.
3. Neuro control and its application - S.OMATU, M.KHALID, R.YUSOF. Spring Verlag London Ltd. 1996.
4. An introduction to fuzzy control - D.DRIANKOV, H. HELLENDOORN and M REINFRANK Narosa Publication House, 2nd reprint 1997.
5. Neural Network Design, - Hagan, Demuth Deak Thomson Learning.

EPE 616 Analysis of Power Electronics Converter

	L	T	P
Credit	3	0	0
Hours	3	0	0

CO1: Competency in function of various power electronics devices.

CO2: Skill of analysing power electronic devices.

CO3: Know-how of advance Power electronics converter.

CO4: Fitness in mitigating converter harmonics.

Phase Controlled Converters: Performance measures of single and three-phase converters with discontinuous load current for R, RL and RLE loads. Effect of source inductance for single and three phase converters.

Chopper: Review of choppers configurations, Steady state analysis of type A Chopper-Minimum and Maximum Currents, Ripple and average load current. Commutation in Chopper Circuits.

Inverters: Performance parameters, Principle of Operation, Single-phase bridge inverters, Three phase bridge Inverters: 180 and 120 degree of conduction, Current source inverters , voltage control of three phase inverters-Sinusoidal PWM, Third Harmonic PWM, 60 degree PWM and Space Vector Modulation. Harmonic reductions.

AC Voltage Controllers: Principle of On-Off Control, Principle of Phase control, Single Phase Bi-directional Controllers with Resistive Loads, Single Phase Controllers with Inductive Loads, Three Phase full wave AC controllers, AC Voltage Controller with PWM Control.

Cyclo-converters: Single phase and three phase Cyclo-converters. Reduction in Output Harmonics, Matrix Converter.

Text and Reference books

1. Advanced Power electronics – Vinod Kumar, R. R. Joshi, R C Bansal, Agarwal and Sharma, Vardhan Publication and distributors, Jaipur, India.
2. Power electronics – N. Mohan, John Wiley student edition, Singapore.
3. Power electronics : circuits, drives and applications – H Rashid, , Pearson, India.

EPE 617 Modeling & Analysis of Electrical Machine

	L	T	P
Credit	3	0	0
Hours	3	0	0

CO1: Know-How of Electromagnetic energy conversion techniques.

CO2: Competency in modelling asynchronous & synchronous induction machine.

CO3: Ability to analyse steady state & dynamic operation of induction machine.

CO4: Capability in contriving drive operation as per the industry requirements.

Basic principle of Electrical Machines: Introduction, Magnetically coupled circuit, Electromagnetic energy conversion, machine winding and air gap EMF, winding inductance and voltage equations, equation of transformation, Reference-Frame Theory.

Fundamental of Electrical Drives: Introduction, Choice of Electrical Drives, Dynamics of Electrical Drives, Concept of Multi-quadrant operation, Components of load torques, Selection of motor power rating, Speed torque, speed control, Starting, Braking.

Symmetrical Induction Machines: Introduction, voltage and torque equations in machine variables, voltage and torque equations in arbitrary reference frame, Analysis of steady state and dynamic operation.

Synchronous Machines: Introduction, voltage and torque equations in machine variables, voltage equations in rotor reference frame, Analysis of steady state and dynamic operation.

References / Suggested Text Books

1. P. C. Krause, Oreg Wasynczuk, Scott D. Sudhoff P.C. Krause, Oreg Wasynczuk, Scott D. Sudhoff, “Analysis of Electric Machinery and drive systems” , IEEE Press, 2002.
2. P. S. Bhimbra, “Generalised Theory of Electrical Machines", Khanna Publications 2013.
3. G. K. Dubey, “Fundamentals of Electrical Drives” Narosa, 2009.
4. G. K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall international, New Jersey, 1989.
5. R. Krishnan, “Electric Motor Drives Modeling, Analysis and Control” PHI-India, 2005.

EPE 618 Power System Optimization

	L	T	P
Credit	3	0	0
Hours	3	0	0

CO1: Know-How of load dispatch in thermal and hydro-thermal system.

CO2: Competency in non-linear programming techniques.

CO3: Ability in contriving Unit commitment and maintenance scheduling.

CO4: Capability in Security constrained optimization.

Economic load dispatch in thermal and hydro-thermal system; reactive power. optimization; optimal power flow. Linear programming and non-linear programming techniques to optimal power flow problems. Security constrained optimization. Unit commitment and maintenance scheduling, interchange evaluation, minimum emission dispatch.

Text and Reference books

1. Optimisation techniques in power systems – Sawla / Hatteres, New age International, India.
2. Optimisation-Theory and Applications, Wiley Eastern Ltd. - S. S. Rao.
3. Optimisation Methods for Engineering Design, Addison Wesley - R. L. Fox.

EPE 621 Selected Topics in Power System and Control

	L	T	P
Credit	2	0	1
Hours	2	0	2

CO1: Know-How of Reactive Power flow and voltage stability in power systems.

CO2: Competency in voltage collapse analysis.

CO3: Ability in singular value decomposition.

CO4: Capability in designing Dynamic voltage stability.

Reactive Power flow and voltage stability in power systems: Physical relationship indicating dependency of voltage on reactive power flow - reactive power transient stability; Q-V curve; definition of voltage stability, voltage collapse and voltage security. Voltage collapse phenomenon, Factors of voltage collapse, effects of voltage collapse, voltage collapse analysis.

Voltage stability static indices : Development of voltage collapse index – power flow studies – singular value decomposition – minimum singular value of voltage collapse – condition number as voltage collapse index.

Voltage stability margins &Improvement of voltage stability: Stability margins, voltage stability margin of un compensated and compensated power system. Dynamic voltage stability – voltage security, Methods of improving voltage stability and its practical aspects.

References

1. Performance operation and control of EHV power transmission SystemsAchakrabarti. D.P.Kothari, A.K. Mukhopadhyay, A.H. Wheeler publishing, 1995.
2. Power system Voltage stability - C.W. Taylor, Mc. Graw Hill, 1994.

EPE 622 Utility Applications of Power Electronics

	L	T	P
Credit	2	0	1
Hours	2	0	2

CO1: Know-how of equipment of converter station.

CO2: Ability to develop Mathematical model of each technique.

CO3: Compentency in designing FACTS controllers.

CO4: Capability to design Active power filters.

Power Converters in Static Excitation Systems.

HVDC Transmission: Basic scheme and equipment of converter station, 12 – pulse converter, converter unit, converter operation, fitters, reactive power source, ground return and ground electrode, Converter Circuits: Rectification and inversion, effect of reactance, six pulse and twelve pulse converter circuits; Multi Terminal DC (MTDC) Systems: Types of MTDC systems, Comparison of series and parallel MTDC systems, Control and protection of MTDC systems, Application of MTDC systems.

FACTS: Static shunt compensators: Objectives, Methods of controllable VAR generation, Static VAR compensators SVC, and STATCOM, Comparison between SVC, TATCOM and static VAR systems; Static series compensators: Objectives, Variable impedance type, Switching converter type, System control and comparison, Combined compensators: PFC, IPFC, Generalized and multi functional FACTS controllers

Active power filters: Types, shunt active filters, Series active filters

Text and Reference books

1. Padiyar.K.R., HVDC Transmission Systems, New Age International, 2006.
2. Mohan.N, Undeland.T.M., Robbins.W.P., Power Electronics, John Wiley & Sons (Asia) Pte. Ltd, 3rd ed., 2003.
3. Rashid.M.H(Ed)., Power Electronics Handbook, Elsivier, 2001.
4. Padiyar. K.R., FACTS Controllers in Power Transmission & Distribution, New Age International, 2007.

EPE 623 Analysis & Control of Electrical Drive Systems

	L	T	P
Credit	3	0	0
Hours	3	0	0

CO1: Know-how of dynamics of electric drive.

CO2: Ability to develop Regenerative Braking, dynamic braking and plugging.

CO3: Compentency in designing Dual-converter control of DC drive.

CO4: Capability to contrive Transient analysis motor drive system.

DYNAMICS OF ELECTRIC DRIVES: Dynamic conditions of a drive system, Energy loss in transient operations, steady state stability, load equalization, close loop configurations of drives.

DC DRIVES: Basics of DC machines, Speed torque curves, torque and power limitation in armature voltage and field control, Starting, Braking-Regenerative Braking, dynamic braking and plugging, Transient analysis of separately excited motor with armature and field control, Energy losses during transient operation, Speed Control-Controlled Rectifier fed DC drives, Dual-converter control of DC drive, Chopper Controlled DC drives

INDUCTION MOTOR DRIVES: Basics of Induction Machines, Starting, Braking-Regenerative braking, plugging and dynamic braking, Transient analysis, Calculation of energy losses, Speed Control-Stator voltage control, variable frequency control from voltage source, Voltage Source Inverter (VSI) Control, Variable frequency control from current source, Current Source Inverter (CSI) Control, Cyclo-converter Control, Static rotor resistance control, Slip Power Recovery- Stator Scherbius drive, Static Kramer drive.

SYNCHRONOUS MOTOR DRIVE: Control of Synchronous Motor-Separately Controlled and VSI fed Self-Controlled Synchronous Motor Drives. Dynamic and Regenerative Braking of Synchronous Motor with VSI, Control of Synchronous Motor Using Current Source Inverter (CSI), Speed control – variable frequency control, Cycloconverters control

Text and Reference books

1. Power electronics and A C Drives – B K Bose, Pearson, India.
2. Power electronics: circuits, drives and applications – H Rashid, Pearson, India.
3. A C Drives – J M D Murphy, John Wiley student edition.

EPE 624 Wind Energy Conversion System

	L	T	P
Credit	3	0	0
Hours	3	0	0

CO1: Aptitude & proficiency in grid interconnection requirements for wind farms.

CO2: Ability of integrating power electronics device with Renewable Energy Soures.

CO3 : Know-how of Wind Power Control.

CO4: Skill in developing MPPT techniques.

Modern power electronics technology for the integration of renewable energy sources, various topologies of power electronics converters (PECs), grid interconnection requirements for wind farms, integration issues, operational issues, grid integration issues in India, challenges for grid integration, wind power integration standards, supergrid strategy, IEC standards for wind turbines

Power electronics in wind power plants, power electronics converters (PEC) classifications, Applications of PEC in wind power plants, Modern PEC in wind power plants.

Maximum power point tracking-Methods, Generators and speed control used in wind power energy, Wind Power Control

Text Books/References

1. Wind power plants and projects developments, Joshua Earnest and T Wizelius, PHI, New Delhi, 2011.
2. Handbook of renewable energy technology, World Scientific, Siongapore, 2011.

EPE 625 Power Electronics Application for Renewable Energy

	L	T	P
Credit	3	0	0
Hours	3	0	0

CO1 : Proficiency in grid interconnection requirements for wind farms.

CO2 : Ability of integrating power electronics device with Renewable Energy Soures.

CO3 : Know-how of the integration technology of renewable energy sources.

CO4 : Skill in resolving operational issues relating to grid integration.

Modern power electronics technology for the integration of renewable energy sources, various topologies of power electronics converters (PECs), grid interconnection requirements for wind farms, integration issues, operational issues, grid integration issues in India, challenges for grid integration, wind power integration standards, supergrid strategy, IEC standadrds for wind turbines, power electronics in wind power plants, power electronics converters (PEC) classifications, Applications of PEC in wind power plants, Modern PEC in wind power plants. Power electronics in PV system.

Text Books/References

1. Wind power plants and projects developments, Joshua Earnest and T Wizelius, PHI, New Delhi, 2011.
2. Handbook of renewable energy technology, World Scientific, Siongapore, 2011.

EPE 626 Power Quality in Distributed System

	L	T	P
Credit	3	0	0
Hours	3	0	0

CO1 : Proficiency in Power Quality solutions.

CO2 : Ability in Controlling Harmonics.

CO3 : Know-how of Power Quality Monitoring.

CO4 : Skill in resolving operational issues relating to Power Quality.

Introduction to Power Quality : Voltage Quality, The power quality evaluation procedure-Need for a consistent-Vocabulary, General classes of power quality problems, Transients, Long-Duration voltage variations, Short-Duration voltage variations, Voltage Imbalance, waveform distortion, voltage fluctuation, Power frequency variations, Power quality terms

Voltage Sags and Interruptions: Sources of sags and interruptions-Estimating Voltage sag performance-Fundamental principles of protection-Solutions at the End-User level-Evaluating the economics of different ride_ through alternatives-Motor_ starting sags-Utility system fault_ clearing issues.

Fundamentals of Harmonics: Harmonic Distortion-Voltage versus current distortion-Harmonic versus Transients-Power system Quantities under non sinusoidal conditions-Harmonic indices-Harmonic sources from commercial loads-Harmonic sources from industrial loads-Locating harmonic sources-System response characteristics-Effects of harmonic distortion- Inter harmonics.

Applied Harmonics: Harmonic Distortion Evaluation-Principles of Controlling Harmonics-Where to control Harmonics? - Harmonic studies-Devices for controlling Harmonic Design- Harmonic filter Design.

Power Quality Monitoring and solutions: Monitoring considerations-Historical perspective of power quality measuring instruments-Power quality measurement equipment-Assessment of power quality measurement data-Application of intelligent systems-Power quality monitoring standards, Conventional and active power quality conditioners.

References / Suggested Text Books

1. Electrical power systems quality-Roger C.Dugan- McGraw- Hills.
2. Power quality- C.Sankaran, CRC Press.
3. Electrical power systems quality-Roger C.Dugan- McGraw- Hills.
4. Power quality- C.Sankaran, CRC Pressaul.

EPE 627 Power System Reliability

	L	T	P
Credit	3	0	0
Hours	3	0	0

CO1: Proficiency in Probability theory applicable to Power System Reliability.

CO2: Ability in Reliability Analysis.

CO3: Know-how of Composite Systems Reliability Analysis.

CO4: Skill in Reliability model of a generation system.

Basics of Probability theory & Distribution: Basic probability theory – rules for combining probabilities of events – Bernoulli's trials – probabilities density and distribution functions – binomial distribution – expected value and standard deviation of binomial distribution.

Network Modelling and Reliability Analysis: Analysis of Series, Parallel, Series-Parallel networks – complex networks – decomposition method.

Reliability functions: Reliability functions f(t), F(t), R(t), h(t) and their relationships – exponential distribution – Expected value and standard deviation of exponential distribution – Bath tub curve – reliability analysis of series parallel networks using exponential distribution – reliability measures MTTF, MTTR, MTBF.

Markov Modelling: Markov chains – concept of stochastic transitional probability Matrix, Evaluation of limiting state Probabilities. – Markov processes one component repairable system – time dependent probability evaluation using Laplace transform approach – evaluation of limiting state probabilities using STPM – two component repairable models.

Frequency & Duration Techniques: Frequency and duration concept – Evaluation of frequency of encountering state, mean cycletime, for one , two component repairable models – evaluation of cumulative probability and cumulative frequency of encountering of merged states.

Generation System Reliability Analysis: Reliability model of a generation system– recursive relation for unit addition and removal – load modeling - Merging of generation load model – evaluation of transition rates for merged state model – cumulative Probability, cumulative frequency of failure evaluation – LOLP, LOLE.

Composite Systems Reliability Analysis: Decompositions method – Reliability Indices – Weather Effects on Transmission Lines.

Distribution System and Reliability Analysis: Basic Concepts – Evaluation of Basic and performance reliability indices of radial networks.

Reference Books

1. Reliability Evaluation of Engg. System – R. Billinton, R.N.Allan, Plenum Press, New York.
2. Reliability Evaluation of Power systems – R. Billinton, R.N.Allan, Pitman Advance Publishing Program, New York.
3. An Introduction to Reliability and Maintainability Engineering. Charles E. Ebeling, TATA McGraw- Hill – Edition.

EPE 631 Seminar

CO1: Know-how of technology trends.

CO2: Ability to analyze burning engineering issues .

CO3: Proficiency in communication skills & presentation.

CO4: Competency in devising solution/ point-of-view for the specific problem.

EPE 632 Preliminary

CO1: Know-how of technology trends.

CO2: Ability to relate problem aspects in system design .

CO3: Proficiency in interdisciplinary problem solns.

CO4: Competency in devising solution/ point-of-view for the specific problem.

EPE 633 Thesis

CO1: Ability in framing problems relating to any specific engineering systems.

CO2: Know-how of dynamic modeling & solution tools.

CO3: Proficiency in hardware implementation.

CO4: Competency in Designing system solutions & evaluation.

Note:

1. For supporting courses course description, which are offered by other departments, refer separately syllabus of that particular department.
2. For syllabus of Non-Credit Compulsory Courses, see at the end.

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

VISION

The vision of the department is to become a centre of excellence for development of environment friendly cutting edge technologies for all domains of Electronics & Communication Engineering and be recognized as the focal point for catalyzing the growth of the technology and to produce skilful and high quality post graduate engineers supported by up-to-date curriculum and scientific and industrial research exposure to suit the industry and the society.

MISSION

Impart education and updated knowledge to make students competent enough in the areas of Electronics & Communication Engineering by imparting quality education and training in global perspectives with optimal mix of inputs on Electronics & Communication Engineering in various domains like VLSI, RF Electronics, Telecommunication, Sensors, Nanotechnology, IOTs. Fully committed to provide need based quality education in all the major areas to the students so that they can not only contribute to their personal development and prosperity of the society, state and the nation as a whole but also build a leading and successful career in this field and can work in rural areas for the development of society as well as aid in relieving the pressure of energy deficiency.

Programme Educational Objectives

1. To provide students with a sound foundation in the Electronics & Communication Engineering fundamentals. A post graduate must be able to understand electronics technologies and to engage in an integrated system-level design.
2. A post graduate student must have analytical and logical aptitude to quickly adapt to new work environments, assimilate new information, and solve new problems. To inculcate self learning, discipline and leadership qualities with good communication skills and to introduce themselves

to holistic approach of working in a team according to the codes of professional practice. The student must have sound understanding of the Electronics & Communication Engineering and related fields and necessary perspective to pursue work in Electronics Engineering related industries and fields so as to cover the whole spectrum of Electronics & Communication Engineering.

3. To provide exposure of new cutting edge technologies to the students and to motivate them to take up new challenges to solve the problems faced by society and nation through research and development.

Programme Outcome

1. Post graduate scholars with skills and expertise to design, install and commission projects on broadband communication, VLSI, Energy Harvesting, etc.
2. Generate adequate trained man power for implementing national mission and policies of government related to electronics harnessing in our country.
3. Prepare cadre of research scholars for achieving entrepreneurial skills and self employment opportunities in electronics & communication engineering sector.

Semester-wise Scheme for Post Graduate Programme in Electronics & Communication Engineering

Details of courses offered for the award of M.Tech. (ECE) in Electronics & Communication Engineering

S. No.	Title	Course No.	Cr. Hr.	Semester			
				I	II	III	IV
Core Courses: Total 12 credits, two courses in first semester (6 credits) and one course each in second and third semester (3 credits each) to be evaluated externally.							
1.	Signal Theory & Applications	ECE 511	3 (2+1)	3	-	-	-
2.	Advanced Optical Communication Systems	ECE 512	3 (2+1)	3	-	-	-
3.	Satellite Communication	ECE 521	3 (2+1)	-	3	-	-
4.	Mobile Communication	ECE 531	3 (2+1)	-	-	3	-
Optional (Major) Courses: Total 15 credits, two courses in first and second semester each (6 credits in each semester) and one course in third semester (3 credits).							
1.	High Speed Communication Networks	ECE 513	3 (2+1)	3	-	-	
2.	Broadband Wireless Technologies	ECE 514	3 (2+1)	3	-	-	
3.	Information Processing & Coding Techniques	ECE 515	3 (3+0)	3	-	-	-
4.	Microwave Communication and Remote Sensing	ECE 516	3 (2+1)	3	-	-	-
5.	Detection and Estimation Theory	ECE 517	3 (3+0)	3	-	-	-
6.	Telecommunication Switching & Networks	ECE 522	3 (2+1)	-	3	-	-
7.	Queuing Systems	ECE 523	3(3+0)	-	3	-	-
8.	Advance VLSI Design	ECE 524	3 (2+1)	-	3	-	-
9.	Advanced Digital Communication Systems	ECE 525	3 (2+1)	-	3	-	-
10.	Modern Telephone Switching Systems	ECE 526	3 (2+1)	-	3	-	-
11.	Nano Technology	ECE 527	3 (3+0)	-	3	-	-
12.	Digital Communication Receivers	ECE 532	3 (2+1)	-	-	3	-
13.	Advanced Techniques for Wireless Reception	ECE 533	3 (2+1)	-	-	3	-
14.	RF Micro-Electro-Mechanical Systems	ECE 534	3 (3+0)	-	-	3	-
15.	Computer Communication	ECE 535	3 (3+0)	-	-	3	-
Minor & Supporting Courses: Total 9 credits, one course in first, second and third semester each (3 credits in each semester).							
1.	Optimization Techniques	BS 514	3 (3+0)	3	-	-	-
2.	Higher Mathematics	BS 515	3 (3+0)	3	-	-	-
3.	Embedded System Design	CSE 513	3 (3+0)	3	-	-	-
4.	Advance Network Security	CSE 523	3 (2+1)	-	3	-	-
5.	Soft Computing	CSE 527	3 (2+1)	-	3	-	-
6.	Methods of Numerical Analysis	BS 521	3 (3+0)	-	3	-	-
Others							
	Compulsory Courses; {(0+1) or (1+0)} Non Credit (NC); PGS Series	PGS501/ 502/...	1	NC	NC	-	-
	Seminar (0+1)	ECE 536	1	-	-	1	-
	Comprehensive	ECE 537	NC	-	-	NC	-
	Research (Thesis). Thesis minimum duration 2 semesters	ECE 538	20	-	-	-	20
	Total credits to be offered (for Master Programme)		**57**	**15**	**12**	**10**	**20**

COURSE SUMMARY

Courses	No. of Courses					Credit Hours
	Semester					
	I	II	III	IV	Total	
Core	2	1	1	-	4	12
Optional	2	2	1	-	5	15
Minor & Supporting	1	1	1	-	3	9
Seminar	-	-	1	-	1	1
Comprehensive	-	-	-	1	1	Non Credit (graded as satisfactory/ non satisfactory)
Research (Thesis)	-	-	-	1	1	20* (graded as satisfactory/ non satisfactory)
Compulsory Courses (PGS Series)	1	1	-	-	2	Non Credit
Total	**6**	**5**	**4**	**2**	**17**	**57**

*Research (Thesis) credit load is not counted in calculation of final OGPA.

Details of courses offered for the award of Ph.D. (ECE) in Electronics & Communication Engineering

S. No.	Title	Course No.	Cr. Hr.	Semester			
				I	II	III	IV-VI
Core Courses: Total 6 credits (3 credits in each semester) one course in first semester and one course in second semester to be evaluated externally.							
1.	Signal Theory & Applications	ECE 511	3 (2+1)	3	-	-	-
2.	Advanced Optical Communication Systems	ECE 512	3 (2+1)	3	-	-	-
3.	Satellite Communication	ECE 521	3 (2+1)	-	3	-	-
4.	Mobile Communication	ECE 531	3 (2+1)	-	-	3	-
5.	Wireless Broadband Communication	ECE 611	3 (2+1)	3	-	-	-
6.	Microwave Circuits	ECE 621	3 (2+1)	-	3	-	-
Optional (Major) Courses: Total 12 credits (6 credits in each semester) two courses in first and second semester each.							
1.	High Speed Communication Networks	ECE 513	3 (2+1)	3	-	-	
2.	Broadband Wireless Technologies	ECE 514	3 (2+1)	3	-	-	
3.	Information Processing & Coding Techniques	ECE 515	3 (3+0)	3	-	-	-
4.	Microwave Communication and Remote Sensing	ECE 516	3 (2+1)	3	-	-	-
5.	Detection and Estimation Theory	ECE517	3 (3+0)	3			
6.	Smart Antennas	ECE 612	3 (2+1)	3	-	-	-
7.	WDM Optical Networks	ECE 613	3 (3+0)	3	-	-	-
8.	MIMO Theory & Applications	ECE 614	3 (2+1)	3	-	-	-
9.	Digital Signal Processing structures for VLSI	ECE 615	3 (2+1)	3	-	-	-
10.	Telecommunication Switching & Networks	ECE 522	3 (2+1)	-	3	-	-
11.	Queuing Systems	ECE 523	3(3+0)	-	3	-	-
12.	Advance VLSI Design	ECE 524	3 (2+1)	-	3	-	-
13.	Advanced Digital Communication Systems	ECE 525	3 (2+1)	-	3	-	-
14.	Modern Telephone Switching Systems	ECE 526	3 (2+1)	-	3	-	-
15.	Nano Technology	ECE 527	3 (3+0)	-	3	-	-
16.	Neural Networks	ECE 622	3 (3+0)	-	3	-	-
17.	High Frequency Electronics	ECE 623	3 (2+1)	-	3	-	-
18.	Synthetic Aperture Radar and Applications	ECE 624	3 (2+1)	-	3	-	-
19.	Data Compression & Cryptography	ECE 625	3 (2+1)	-	3	-	-
20.	Digital Communication Receivers	ECE 532	3 (2+1)	-	-	3	-
21.	Advanced Techniques for Wireless Reception	ECE 533	3 (2+1)	-	-	3	-
22.	RF Micro-Electro-Mechanical Systems	ECE 534	3 (3+0)	-	-	3	-
23.	Computer Communication	ECE 535	3 (3+0)	-	-	3	-
Minor & Supporting Courses*:* Total 9 credits, two courses in first semester (6 credits) and one course in second semesters (3 credits).							
1.	Optimization Techniques	BS 514	3 (3+0)	3	-	-	-
2.	Higher Mathematics	BS 515	3 (3+0)	3	-	-	-
3.	Embedded System Design	CSE 513	3 (3+0)	3	-	-	-
4.	Numerical analysis of Differential Equation	BS 611	3 (3+0)	3	-	-	-
5.	Advance Network Security	CSE 523	3 (2+1)	-	3	-	-
6.	Soft Computing	CSE 527	3 (2+1)	-	3	-	-
7.	Methods of Numerical Analysis	BS 521	3 (3+0)	-	3	-	-
8.	Advance Mathematics for Computing	BS 621	3 (3+0)	-	3	-	-
Others							
	Compulsory Courses+; {(0+1) or (1+0)} Non Credit (NC); PGS Series	PGS501/502/...	1	NC	NC		-
	Seminar	ECE 691/ 692	1(0+1)	1	1	-	-
	Preliminary	ECE 632	NC			NC	
	Research (Thesis). Thesis minimum duration 4 semesters	ECE 633	45	-	-	-	45
	Total credits to be offered		**74**	**16**	**13**	**-**	**45**

Note: A Ph.D. student must take two 600 series core courses. A student may choose optional/minor & supporting courses of 500 series courses if not studied during Masters Programme as per ICAR guidelines.

\+ Exempted for those who have cleared these in Master's Programme (permission to be sought from the Dean, CTAE).

COURSE SUMMARY

Courses	No. of Courses							Credit Hours
	Semester							
	I	II	III	IV	V	VI	Total	
Core	1	1	-	-	-	-	2	6
Optional	2	2	-	-	-	-	4	12
Minor & Supporting	2	1	-	-	-	-	3	9
Seminar	1	1	-	-	-	-	2	2
Preliminary	-	-	1	-	-	-	1	Non Credit (graded as satisfactory/ non satisfactory)
Research (Thesis)	-	-	-	-	-	1	1	45* (graded as satisfactory/ non satisfactory)
Compulsory Courses** (PGS Series)	1	1	-	-	-	-	2	Non Credit
Total	**7**	**6**	**1**	-	-	**1**	**15**	**74**

*Research (Thesis) credit load is not counted in calculation of final OGPA.

**Exempted for those who have cleared these in Master's Programme.

SYLLABUS

ELECTRONICS & COMMUNICATION ENGINEERING

CORE COURSES

ECE 511 **Signal Theory & Applications** **Credits: 3(2+1)**

Course Outcome

In this course student's learn to distinguish between different types of error correcting codes based on probability of error and bit Energy to noise ratio. They are also able to understand the basic concepts of two dimensional signal acquisition, sampling, quantization, spatial filtering techniques, including linear and nonlinear methods.

Syllabus: Representation of deterministic signals: Orthogonal representation of signals. Dimensionality of signal spaces. Construction of orthogonal basis functions.

Random Processes: Definition and classification, stochastic integrals, Fourier transforms of random processes, stationary and non-stationary processes, correlation functions. Ergodicity, power spectral density, transformations of random processes by linear systems.

Representation of random processes (via sampling, K-L expansion and narrow band representations), special random processes: white Gaussian noise, Wiener-Levy process, Poisson process, shot-noise process, Markov process.

Optimum Filtering: Matched filters for deterministic signals in white and colored Gaussian noise. Wiener filters for random signals in white and colored Gaussian noise.

Reference Books

1. J.G.Proakis et al, Advanced Digital Signal Processing, McGraw –Hill.

2. S.Haykin, Adaptive Filter Theory (3/e), Prentice- Hall.

ECE 512 **Advanced Optical Communication Systems** **Credits: 3(2+1)**

Course Outcome:

Students are able to analyse, model and implement advanced optical communication systems and also able to use optical communications simulation tools to assess the results obtained from theoretical studies. The subject also makes them aware about the optical filters, isolators, circulators, dispersion etc.

Syllabus: Optical fibers: review of fundamentals, Signal distortion and attenuation, Intermodal and intramodal dispersion, dispersion flattened and dispersion compensated fibers, Profile dispersion and study of PMD. Laser diode and photodiode, Photo detector noise analysis, Analog and Digital

communication link design. WDM, DWDM, optical couplers, Mach-Zehnder interferometer multiplexer, optical add/drop multiplexers, isolators, circulators, optical filters, tunable sources and tunable filters, arrayed waveguide grating, diffraction grating, optical amplifiers, optical integrated circuits .Characterization of optical fibers, OTDR. SONET: frame format, overhead channels, payload pointer, Virtual tributaries, multiplexing hierarchy.

SDH: Standards, frame structure and features.

Optical switching, WDM networks.

Classification of optical sensors: Intensity modulated, phase modulated and spectrally modulated sensors.

Reference Books

1. G. Keiser, “Optical Fiber Communication (3rd Edition) “, McGraw Hill International.

2. C.S.Murthy & M.Gurusamy, WDM Optical Networks, PHI.

3. G.P.Agrawal, Non linear Fiber Optics, (3/e), Elsevier.

ECE 521 **Satellite Communication** **Credits: 3(2+1)**

Course Outcome

In this course, students learn the fundamentals and the techniques for the design and analysis of satellite communication systems and high levels of technical competence in the field. After going through they are able to apply problem solving approaches to work challenges and make decisions using sound engineering methodologies.

Syllabus: Evolution of Satellite Technology, Communication Satellites, Satellite frequency Bands. Satellite Channel analysis, cross-links, Carrier to Noise ratios, Frequency reuse with spot beams. Multiple beams.

Satellite front end, Front-end noise. Noise temperature, Front end filters. Satellite multiple access methods. FDMA, TDMA, CDMA Systems, DS-CDMA and frequency hopped CDMA, Satellite jamming, Code acquisition and tracking. Satellite applications. Data Communication and VSAT network. Mobile satellite services (GEO and NON GEO).

Reference Books

1. The Satellite Communication applications handbook. By Brauce. R. Elbert Artech House, Inc.

2. Satellite Communication by Robert M. Gagliardi, CBS Publisher.

3. Digital Satellite Comm By Tri T. Ha, Mc Graw Hill.

ECE 531 **Mobile Communication** **Credits: 3(2+1)**

Course Outcome

In this course students get knowledge about technologies used in wireless communication, overall GSM cellular concept, multiple access technologies& the effect of fading and different fading models with study of different spread spectrum & diversity techniques.

Syllabus: Cellular concept. Mobile radio propagation. Co-channel interference. Diversity. Multiple accesses. Cellular coverage planning. Wireless networking. Wireless systems and standards. Fading channels, spreading codes, power control. WAP and other protocols for internet access. Data transmission in GSM and UMTS, TCP in wireless environment, multi-user detection and its performance analysis. Blue-tooth and other wireless networks, system comparison. Spread spectrum concept. Basics of CDMA. Properties and generation of PN sequences. Applications of CDMA to cellular communication systems. Second and third generation CDMA systems/standards. Multicarrier CDMA. Synchronization and demodulation .Diversity techniques and rake receiver.

Reference Books

1. Wireless Digital Communication- Feher, PHI.
2. Principles & applications of GSM – Vijay K. Garg, and J.E. Wilkes – Prentice hall PTR.
3. Mobile Cellular Telecomm. Lee Mc Graw Hill Inc.

ECE 611 **Wireless Broadband Communication** **Credits: 3(2+1)**

Course Outcome

In this course students understand concept of digital communications and modulation as used in wired and wireless transmission. Receiver techniques for digital modulation links, Introduction of key wireless systems GSM, WCDMA and WLAN. Basic principles involved in data communication systems, data network architecture, operation, and performance analysis.

Syllabus: Small scale Multipath Propagation, Impulse response Model of a multipath Channel, Small-scale fading Measurements, Parameters of Mobile Multipath, Types of small-scale fading, Rayleigh & Ricean distribution, Statistical models for multipath fading channels, Theory of multipath shape factors for small scale fading wireless channels, Fading behavior, Second order statistics using shape factors.

Line coding, Pulse shaping techniques, Geometric representation of modulation techniques, Linear modulation techniques, Constant envelope modulation, Combined linear and constant envelope modulation techniques, Modulation performance in fading multipath channels.

Fundamentals of equalization, Training a Generic Adaptive Equalizer, Equalization in a communication receiver, Equalization techniques, Linear equalizers, Non-linear equalizers, Adaptive equalization, Diversity techniques , Rake receiver, Interleaving.

Reference Books

1. Wireless Communication-Rappaport.
2. Principles & applications of GSM – Vijay K. Garg, and J.E. Wilkes – Prentice hall PTR.
3. Mobile Cellular Telecomm. Lee Mc Graw Hill Inc.

ECE 621 **Microwave Circuits** **Credits: 3(2+1)**

Course Outcome

The main objective of this course is to help the students to get the knowledge of microwave components, planar transmission lines, design parameters and applications. Students are also able to acquire the knowledge of mixers, inverters, filters, microwave amplifier design, oscillator design and skills needed to design and analyze microwave circuits and systems.

Syllabus: Two-port network characterization. Scattering matrix representation of microwave components. Planar transmission lines; characteristics, properties; design parameters and applications. Design of mixers.MIC filters. Kuroda transformation, K inverter, J inverter. Resonator filters.Realization using microstrip lines and strip lines. Microwave amplifier design. Power gain equations. Maximum gain design. Low noise design. High power design. Stability considerations.Microwave oscillator design. One port and two port negative resistance oscillators. Oscillator design using large – signal measurements.

Reference Books

1. G.Gonzalez, Microwave Transistors and Amplifiers, Prentice- Hall, Englewoo Cliffs.
2. S.Y.Liao, Microwave Amplifier and Oscillator Design, Pearson Education.
3. Soohoo, Microwave Electronics, Addison Wesley.

MAJOR COURSES

ECE 513 High Speed Communication Networks Credits:3(2+1)

Course Outcome

The students learn to design protocol models for broadband ISDN and designing of various traffic models.An Introduction to design of mobile ad-hoc networking and design of application layer in weh,HTTP,FTP etc.

Syllabus: Broadband ISDN. Protocol reference model. SDH- Basic features. ATM standards. Multistage networks. Traffic models; delay and loss performance. Cell switching. Cell scale and burst scale queuing. Protocol layers, their service and models.Internet protocol stack, link layer and local area networks. Network layer and routing. Transport layer. Congestion control. Application layer protocols. Web and HTTP.FTP and email. Mobile adhoc networking. Routing approaches. Mobile ad hoc networking. Protocol performance and open issues. Clustering and hierarchial routing. Ad hoc network security.

Reference Books

1. S.Basagni, Mobile Ad Hoc Networking, Wiley.
2. J.M. Pitts & J.A. Schormans, Introduction to IP and ATM Design and Performance (2/e), Wiley.
3. C.Siva Ram Murthy & B.S.Manoj, Adhoc Wireless Networks (2/e), Pearson Education.

ECE 514 Broadband Wireless Technologies Credits: 3(2+1)

Course Outcome

This subject enhances the knowledge of Basic cellular concept, including intelligent cell concept, Development and design of trans-receiver systems in wire technologies. Students get knowledge of CDMA applications in broad band and OFDM Techniques.

Syllabus: The Cellular concept, System design, Capacity improvement in cellular systems, Co channel Interference Reduction. Intelligent cell concept and applications Mobile radio propagation, fading, diversity techniques, design parameters at the base station, smart antenna systems, Practical link budget design using path loss models CDMA- Principle, Network design, Link capacity, Power control, RAKE receiver, Channel modeling. WCDMA-Network planning MC-CDMA, Orthogonal frequency division multiplexing, OFDM with code division multiplexing, Cellular mobile communication beyond 3G GSM, IS-95, GPRS, UMTS, WLAN, Bluetooth, beyond 4G.

Reference Books

1. K.Fazel & S. Kaiser, Multi-carrier and Spread Spectrum Systems, Wiley.
2. S.G. Glisic, Advanced Wireless Communications, 4G Technologies, Wiley.
3. W.C.Y.Lee, Mobile Communication Engineering. (2/e), McGraw- Hill.

ECE 515 Information Processing & Coding Techniques Credits: 3(3+0)

Course Outcome

This course covers basic concepts of computational efficient algorithm, entropies and their ensembles. Course provides knowledge of Galois field in binary fields, channel coding and decoding using various codes.

Syllabus: Shannon's fundamental coding theorems, Differential entropy & mutual information for discrete & continuous ensembles, source coding, Rate distortion theory. Introduction to Algebra: Groups, fields, Binary field arithmatic, Basic properties of Galois field GF(2m) and vector spaces. Channel coding & decoding: Run length limited codes, LBC, cyclic code, BCH code, convolutional code, Trellis coded modulation, Reed-Solomon code.

Reference Books

1. Information theory : F.M Reza, McGraw Hill.
2. Digital and Analog Communication Systems: K.Sam Shanmugam, John Wiley.
3. Communication Systems : Analog and Digital : Singh & Sapre, TMH, 1995.
4. Digital Communication: B. Sklar, Pearson Education Asia.

ECE 516 Microwave Communication and Remote Sensing Credits: 3(2+1)

Course Outcome

In this course student is able to learn designing the line of sight and troposcatter communication systems. This course gives exposure to remote sensing and various microwave sensors, using various techniques for remote sensing and radar systems.

Syllabus: Line of sight & troposcatter communications. Channel characterization, Propagation Studies, Performance requirement, Impairments and evolutions of digital and analog communications using Los & troposcatter systems. Design of Los communication Systems, Link calculation. Characterization of sub systems of line of sight communication system. Theory and system Design of troposcatter communication system. Introduction to Microwave remote sensing. Theory and principle of microwave remote sensing. Microwave Sensors both Passive and Active Microwave, Receivers, Radiometers, Real Aperture Radar, Synthetic Aperture Radar, Scatterometers, Altimeters, Antenna System for Microwave Sensors, Characterizationn of Microwave Sensors. Data Processing of Microwave, Data Applications of Passive and Active.Microwave sensors for ocean land and atmosphere from tower aircraft and space craft.

ECE 517 **Detection and Estimation Theory** **Credits: 3(3+0)**

Course Outcome

At the end of the course, student is able to Acquire basics of statistical decision theory used for signal detection and estimation. Examine the detection of deterministic and random signals using statistical models. Comprehend the elements and structure of nonparametric detection, examine the performance of signal parameters using optimal estimators. Analyze signal estimation in discrete-time domain using filters.

Syllabus: Stochastic signal, orthogonal representation of signals, random process, Markov process, correlation function, power spectral density, Tchebycheffi inequality Detection in presence of noise, correlator, optimum filter, matched filter. Weighted probabilities and hypothesis testing, composite hypothesis, likelihood ratio detection, sequential detection. Principles of estimation, properties of estimator, Cramer – Rao Bound, Baye's maximum likelihood and least square estimation, parameter estimation, estimation of continuous waveforms, time invariant linear estimation.

Reference Books

1. Principles of Digital Communication: J. Das, S.K Mullick, P.K Chatterjee, Newage International (P) Ltd publisher, New Delhi.
2. Modern Digital and Analog Communication Systems, B.P Lathi, Oxford publishers.

ECE 612 **Smart Antennas** **Credits: 3(2+1)**

Course Outcome

At the end of the course, student is able to evaluate a system requirement for implementation of an appropriate Smart Antenna implementation. Analyze the channel models for smart antenna systems. Study the environmental parameters for signal processing of smart antenna systems. Evaluate the requirements for the design and implementation of smart antenna systems. Identify the suitable antenna for a given communication system.

Syllabus: Spatial processing for wireless systems. Adaptive antennas. Beam forming networks. Digital radio receiver techniques and software radios. Coherent and non coherent CDMA spatial processors. Dynamic re-sectoring. Range and capacity extension – multi-cell systems. Spatio – temporal channel models. Environment and signal parameters. Geometrically based single bounce elliptical model. Optimal spatial filtering – adaptive algorithms for CDMA. Multitarget decision – directed algorithm. DOA estimation – conventional and subspace methods. ML estimation techniques. Estimation of the number of sources using eigen decomposition. Direction finding and true ranging PL systems. Elliptic and hyperbolic PL systems. TDOA estimation techniques.

Reference Book

1. M.J. Bronzel, Smart Antennas, John Wiley.

ECE 613 **WDM Optical Networks** **Credits: 3(3+0)**

Course Outcome

*In this course, student is able to l*earn about WDM network elements and design. Solve a simple WDM network design and optimization problems. Define the main limitations and possibilities of the optical network technologies. Explain the benefits of optical layer survivability. Describe the main issues in management and control of optical networks.

Syllabus: First generation optical networks. SONET/SDH. Computer interconnects. Metropolitan area networks. Layered architecture. WDM optical network evolution. Enabling technologies. WDM optical network architecture. Wavelength routed networks. Wavelength routing networks. Optical layer. Node designs. Network design and operations. Routing and wavelength assignment. Wavelength convertible networks, performance evaluation. Networks with sparse wavelength conversion. Converter placement and allocation problems. Virtual topology design problem, light path routes, implementation in broadcast and select networks. Submarine Optical Communication, Design Issues and its Parameters, Performance of optical OFDM for trans-oceanic communications.

Reference Books

1. K.M.Sivalingam & S.Subramanium, Optical WDM Networks- Principles & Practice.
2. B.Mukherjee, Optical Communication Networks, (1/e), McGraw Hill.
3. Harold Kolimbins, Fiber Optics Communication, Pearson Publication.
4. David Bailey & Edwin Wright, Practical Fiber Optics , ELSEVIER Publications.

ECE 614 **MIMO Theory & Applications** **Credits: 3(2+1)**

Course Outcome

In this course, student is able to Introduce Multiple Input Multiple Output (MIMO) Communication Systems. Compare MIMO Systems with Single Input Single Output (SISO) Systems. Analyze the Information Theoretic advantages of MIMO Systems. Analyze the spatial multiplexing properties of MIMO. Introduce and analyze space time codes.

Syllabus: Overview of fundamentals of Digital Communications, The Wireless Channel, Detection, Diversity and Channel Uncertainty, Capacity of Wireless channels, Spatial Multiplexing and Channel modeling, Capacity and Multiplexing architectures, Diversity-Multiplexing tradeoff and Universal Space Time Codes, Multi-user Communication.

Reference Books

1. David Tse, Pramod Viswanath, Fundamentals of Wireless Communications, Cambridge University Press.
2. E. Biglieri, Coding for Wireless Channels, Springer.
3. E. Biglieri et al., MIMO Wireless Communications, Cambridge University Press.

ECE 615 Digital Signal Processing structures for VLSI Credits: 3(2+1)

Course Outcome

In this course, student is able to understand the overview of DSP concepts. Improve the speed of digital system through transformation techniques. Perform Pipelining and parallel processing in FIR systems to achieve high speed and low power. Perform Pipelining and parallel processing in IIR systems and adaptive filters. Understand clocking issues and asynchronous system.

Syllabus: VLSI Architectures for DSP algorithms – Data flow representations, pipelining and parallel processing, retiming, unfolding, register minimization techniques, systolic architectures, algorithms for fast implementation of convolution, FIR, IIR and adaptive filters, DCT, analysis of finite word length effects, Low power design strategies; Architecture, programming and applications of general purpose digital signal processors (Emphasis on TI & AD processors); Application case studies: Speech coding, image and video compression, Viterbi decoding, wireless communication.

Reference Books

1. K.K. Parhi, VLSI Digital signal processing systems: Design and implementation, John Wiley.
2. Lars Wanhammar, DSP Integrated Circuits, Academic Press.
3. S.M. Kuo, B.H.Lee, Real-Time Digital Signal Processing: Implementations, Applications, and Experiments with the TMS320C55X, Wiley.

ECE 522 Telecommunication Switching & Networks Credits: 3(2+1)

Course Outcome

After completing this course students shall be able to explain the working principle of switching systems involved in telecommunication switching, Design of multi stage switching structures involving time and space switching stages, Analyze basic telecommunication traffic theory, Build an understanding of the fundamental concepts of computer networking, Familiarize with the basic taxonomy and terminology of the computer networking area.

Syllabus: Principles of circuit switching & signaling schemes, space, time & space time division switching, Single stage & multi stage switching network. Traffic engineering and teletraffic theory. Markov processes representing traffic, calculation of blocking probability.Modeling and analysis of important media access control protocols: ALOHA, slotted ALOHA, CSMA, CSMA/CD. LAN: Ethernet, token ring, FDDI.B-ISDN architecture, B-ISDN protocols, ATM traffic & congestion control, signaling, routing and addressing, Internetworking: switches, bridges, routers, gateways. ATM switching.

Reference Books

1. Vishwanathan, Telecom Switching : PHI.
2. Flood F.E., Telecommunication Networks: Pearson Publications.

ECE 523 **Queuing Systems** **Credits: 3(3+0)**

Course Outcome

At the end of the course, student must be able to define and explain basic concepts in descriptive statistics and probability theory, Define and explain basic concepts in the theory Markov processes, M/M/m, M/M/m/K and M/M/m/K/C queuing systems, Calculate the traffic intensity, blocked traffic and the utilization of some queuing systems, Model communication networks.

Syllabus: Review of probability and stochastic processes. Markov Chains, Little's Theorem. Modeling and analysis of M/M-/- queues. Burke's Theorem. Reversibility, Method of stages Analysis of M/G/1 queues, Queues with vacations, Work conservation principle. Priority queues, queues served in cyclic order, Fluid flow and diffusion approximations.

Reference Books

1. Advances in queuing by Jewegeni H. Dishalalow, CRC Press, Newyork.
2. Frontiers in queuing (Probalilty & stochastic series) by Jewegeni H. Dishalalow, CRC Press, New York.

ECE 524 **Advance VLSI Design** **Credits: 3(2+1)**

Course Outcome

The students will be able to learn advanced technologies in the field of VLSI design along with the fundamental concepts, Use the techniques, skills, modern CAD tools, software and equipment necessary to evaluate and analyse the system in VLSI design environments. Demonstrate semiconductor IC design such as PLA's, PAL, FPGA, CPLD, Demonstrate VHDL synthesis, simulation, design capture tools, design verification tools and CMOS testing and differential strategies for testing of IC's and CMOS testing in particular.

Syllabus: Introduction to VLSI design – motivation for IC design, IC design process, design abstraction levels, CAD tools, elements of system specification and design. Combinational logic design, logic minimization, synchronous sequential logic design. Finite state machines, Mealy and Moore models, Designing with programmable logic devices ROM, PLA, PAL, PLD. A synchronous sequential logic-analysis procedure, state minimization, state assignment, static and dynamic hazards. Introduction to VHDL – basic concepts in VHDL, language features, types of VHDL description – structural, data flow and behavioral descriptions of hardware, combinational and sequential design examples using VHDL. Features and internal structure of CPLDs, FPGAs, designing with CPLDs and FPGAs. Introduction to IC floor planning and testing, design for testability, combinational logic testing, sequential logic testing, ATPG, boundary scan, built in self test. Design examples and case studies

Reference Books

1. VHDL: Analysis and Modeling of digital Systems – Zainalabedin Navabi, Mc Graw Hill, 1993.
2. VHDL Prniter – Bhaskar, PHI, 3rd Edition, 1999.

3. Digital Principles and Design- Donald D. Givone, Tata McGraw Hill, 2002.
4. Digital Design – M.M. Mano, Third Edition, Pearson Education 2001.
5. Digital Design – Principles and Practice – John.F.Wekerly, third edition, Pearson Education 2001.
6. Modern VLSI design – Wayne wolf, Pearson Education, 1997.
7. Specification and Design of Embedded Systems – daniel D. Gajski, Frank Vahid, Sanjiv Narayan, Jie Gong, Prentice Hall 1994.

ECE 525 Advanced Digital Communication Systems Credits: 3(2+1)

Course Outcome

Upon successful completion of this course, the students will be able to: Apply different modulation schemes to baseband signals, Analyse the BERcharacteristics of Baseband Modulated signals, Learn synchronization and adaptive equalization techniques, Construct time and frequency domain models for digital communications systems with linear channels.

Syllabus: Baseband data transmission. Nyquist criterion for zero ISI. Correlative level coding. Data Detection. Optimum design of transmit and receive filters. Equalization. Linear, adaptive, fractionally spaced and decision feedback equalizers. Digital modulation schemes. Carrier synchronization methods. Symbol timing estimation methods. Linear block codes, cyclic codes; encoding and decoding. Non-binary codes. Convolutional codes. Decoding of convolutional codes. Trellis coded modulation. Lattice type trellis codes. Turbo coding. Interleaver, turbo encoder, MAP decoder, Log MAP decoder. Performance measures. D S and F H spread spectrum. CDMA system based on FH spread spectrum signals. Synchronization of spread spectrum signals.

Reference Books

1. S.Haykin, Communication Systems (4/e), Wiley, 2001.
2. R.E.Zimer & R.L. Peterson : Introduction to Digital Communication, PHI, 2001.
3. L.Hanzo etal, Turbo Coding, Turbo Equalization & Space-Time Coding Wiley, 2002.
4. J.G.Proakis, Digital Communication (4/e), McGraw- Hill, 2001.
5. S.Lin & D.J.Costello, Error Control Coding (2/e) Pearson, 2005.

ECE 526 Modern Telephone Switching Systems Credits: 3(2+1)

Course Outcome

After completion of this course student will be able to: Recognize the different internetworking devices and their functions, explain role of protocols in networking, Analyse the services and features of the various layers of data networks, Implementation of various congestion control techniques, Analyse the features and operations of various application layer protocol such as HTTP, DNS and FTP, understand the various routing techniques.

Syllabus: Broadband ISDN. Protocol reference model. SDH- basic features. ATM standard. Multistage networks. Traffic models; delay and loss performance. Cell switching. Cell scale and burst scale queuing. Protocol layers, their service and models. Internet protocol stack, link layer and local area networks. Network layer and routing. Transport layer. Congestion control. Application layer protocols. Web and HTTP.FTP and email. Mobile ad hoc networking. Routing approaches. Mobile ad hoc networking. Protocol performance and open issues. Clustering and hierarchical routing. Ad hoc network security.

Reference Books

1. S.Basagni, Mobile Ad Hoc Networking, Wiley.
2. J.M.Pitts & J.A.Schormans, Introduction to IP and ATM Design and Performance (2/e), Wiley.
3. C.Siva Ram Murthy & B.S.Manoj, Adhoc Wireless Networks (2/e), Pearson Education.

ECE 527 **Nano Technology** **Credits: 3(3+0)**

Course Outcome

The subject will make use of knowledge of nano science and mathematics to follow protocols, conduct science or engineering procedures, fabricate products, make conclusions about results, troubleshoot. To understand the nano lithography. Compile and analyze data and draw conclusions at the nano level.

Syllabus: Introduction to nanoscale systems. Length energy and time scales. Top down approach to Nano lithography. Spatialresolution of optical, deep ultraviolet, X-ray, electron beam and ion beam lithography. Single electron transistors, coulomb blockade effects in ultra small Metallic tunnel junctions. Quantum confinement of electrons in semiconductor nano structures. Two dimensional confinement (Quantum wells), Band gap engineering, Epitaxy, Landaeur,-Buttiker Formulism for conduction in confined geometries, one dimensional confinement, quantum point context, quantum dots and bottom of approach, introduction to quantum methods for information processing. Molecular Electronics, Chemical self assembly, carbon nano tubes, self assembled mono layers, Electomechanical techniques, Applications in biological and chemical detection, Atomic scales characterization techniques, scanning, tunneling microscopy, atomic force microscopy.

Reference Books

1. David Ferry " Transport in Nano structures" Cambridge University press 2000.
1. Y.Imry "Introduction to Mesoscopic Physics, Oxford University press 1997.
2. 3.S.dutta "electron Transport in Mesoscopic system" Cambridge University press 1995.
3. H Grabert and M.Devoret single charge Tunneling" Plenum press 1999.
4. Beenaker and van Houten "Quantum Transport in Semiconductor nanoelectronics solid state Physics" Ehernereich and Turnbell, Academic press, 1991.

ECE 622 **Neural Networks** **Credits: 3(3+0)**

Course Outcome

This course aims at introducing the fundamental theory and concepts of computational intelligence methods, in particular neural networks, fuzzy systems, Genetic algorithms and their applications in the area of machine intelligence.

Syllabus: History of Artificial Neural Networks (ANN), Neuron models, Network architectures, Learning Processes. Single layer and Multilayer perceptrons, Backpropagation Algorithm, Generalization, Function Approximations, Network pruning techniques. Radial Basis Function (RBF) Networks, R egularization theory, Generalized RBF Networks, Estimation of the Regularization parameters, Approximation properties of RBF networks, C omparison of RBF and Multilayer perceptrons. Recurrent Neural Networks, Computational power of recurrent neural networks, learning algorithms, backpropagation through time, Real time recurrent learning. Engineering Applications of ANN, System identification, Adaptive filter design, solving interpolation and ex trapolation problems using ANN, Classification, Function approximation and pattern recognition problems.

Reference Books

1. J.A. Freeman and B.M.Skapure, “Neural Networks, Algorithms Applications and programming Techniques”, Addison – Wesely, 1990.
2. Laurence Fausett, “Fundamental of Nerual Networks: Architecture, algorithms and application”, Prentice Hall, 1994.

ECE 623 **High Frequency Electronics** **Credits: 3(2+1)**

Course Outcome

The main aim of the course is to make students familiar with the high-frequency concepts in Electrical and Electronics Engineering. Since the dimensions of circuits and circuit components designed to operate in microwave frequencies can easily be comparable to the wavelength, they cannot be considered as point-like objects as in the case of lumped model approximations.

Syllabus: Analysis of planar transmission lines: Variational method. losses in microstrip lines, analysis & design of devices; passive circuits, impedance transformers, couplers, power dividers, filters, oscillators, mixers, switches, amplifiers (narrow band /broad band) oscillators, active & passive Phase shifters. Microstrip lines on ferrite and garnet substrate; Isolators and circulators; lumped elements in MICs Analysis of basic transmission lines for millimeter wave frequencies. Integrated finline, image guide and its variants, non-radiative guide, H-guide and groove guide. Millimetre wave devices for generation and detection. Transitions, bends and discontinuities. Monolithic circuit components planar transmission lines lumped and distributed passive elements.

ECE 624 Synthetic Aperture Radar and Applications Credits: 3(2+1)

Course Outcome

To design the basic principles of modern two- and three-dimensional SAR signal processing.To design the methods, limitations, and tradeoffs of modern SAR systems and signal processing. To explore emerging applications in SAR-based target detection, three-dimensional mapping, and change detection.

Syllabus: Overview of Airborne Radar, Principles of Synthetic Array (Aperture) Radar, SAR design considerations, SAR operating modes, Generic Pulse Doppler Radar, Radio waves and Alternating Current Signals, Matched filter and Pulse Compression, Data Compression Techniques in SAR, SAR ground system and SAR processor.

Reference Books

1. George. W.Stimson, Introduction to Airborne RADAR, Scitech Publishing Inc, New Jersey.
2. John C. Curlander, Robert N.McDonough, Synthetic Aperture RADAR Systems & Signal processing, Amazon Publication.
3. Donald R. Wehner, High Resolution Radar, Artech House.

ECE 625 Data Compression & Cryptography Credits: 3(2+1)

Course Outcome

Implement text, audio and video compression techniques. Understand symmetric and asymmetric key cryptography schemes. Understand network security and ethical hacking.

Syllabus: Internet and Communication Protocol, A brief history of Internet OSI TCPIP, the need for tunneling and encryption keys, Tunneling, Internet Protocol security. Deterring Needs – The evaluation of security assessments, assessing needs in house, the management role, and web access question. Containers network bulneralility detection, penetration testing internal security needs. Structured query language security and other specialties. Trends in Internet crime, Denial of service attack, tools, that works for and agmust the Network, IP Spoofing attade the Telnet hole, Language vulnerabilities. Other – Java and Active X, Unix root control, Trojan Hares. Virtual private network, Fire walls and disaster recovery planning, Security tools. Different encryption & decryption algorithm concept of private & Public keys.

Reference Books

1. Introduction to cryptography- H Delfs H. Knebl – 2002 Springer.
2. Introduction to cryptography – J.A. Buchamann – 2001 Springer.
3. Information Security & Cryptography – ICISC 2001, K Kim Ed 2002 vo. 2288 Springer.
4. Understanding data comm. & networks – Shay – Vikas Thomas Pub.
5. Information security & Cryptography – ICISC 2000 by D. Won. Vol 2015 ec. 2001 Springer (lect notes).

ECE 532 Digital Communication Receivers Credits: 3(2+1)

Course Outcome

Apply Digital communication technologies in a variety of engineering applications.

Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency. An ability to understand Synchronization algorithms and estimation. An ability to design optimal receivers for data detection and synchronization parameter estimation. An ability to understand clock recovery circuits and error tracking. an ability to design digital matched filters.

Syllabus: Baseband PAM. Clock recovery circuits. Error tracking and spectral – line generating synchronizers. Squaring and Mueller and Muller synchronizers. Channel models. Receivers for PAM. Optimum ML receivers. Synchronized detection. Digital matched filter. ML synchronization algorithms – DD and NDA. Timing parameter and carrier phase estimation – DD and NDA. Performance analysis of carrier and symbol synchronizers. Feedback and feed forward synchronizers. Cycle slipping Acquisition of carrier phase and symbol timing. Fading channels. Statistical characterization. Flat and frequency selective fading channels. Optimal receivers for data detection and synchronization parameter estimation. Realizable receiver structures for synchronized detection.

Reference Books

1. N.Benuveruto & G.Cherubini, Algorithms for Communication Systems and their Applications, Wiley.
2. H.Meyr & G.Ascheid, Synchronization in Digital Communications, John Wiley.

ECE 533 Advanced Techniques for Wireless Reception Credits: 3(2+1)

Course Outcome

After completion of the course, the students are able to Evaluate the performance of wireless signaling environment. Apply mathematical formulation to find Optimum detection of wireless signal. Analyze wireless channel conditions .Develop signal processing algorithms for wireless signal reception.

Syllabus: Wireless signaling environment. Basic signal processing for wireless reception. Linear receivers for synchronous CDMA. Blind and group-blind multiuser detection methods. Performance issues. Robust multiuser detection for non Gaussian channels; asymptotic performance, implementation aspects. Adaptive array processing in TDMA systems. Optimum space-time multiuser detection. Turbo multiuser detection for synchronous and turbo coded DMA.Narrowband interface suppression. Linear and nonlinear predictive techniques. Code-aided techniques. Performance comparison. Signal Processing for wireless reception: Bayesian and sequential Montecarlo signal processing. Blind adaptive equalization of MIMO channels .Signal processing for fading channels. Coherent detection based on the EM algorithm. Decision-feedback differential detection. Signal processing for coded OFDM systems.

Reference Books

1. Mohamed Ibnkahla, Signal Processing for Mobile Communications, CRC Press.
2. A.V.H. Sheikh, Wireless Communications Theory & Techniques, Kluwer Academic Publications.
3. A.Paulraj etal, Introduction to Space-time Wireless Communications, CambridgeUniversity Press.

EC 534 **RF Micro- Electro-Mechanical System** **Credits: 3(3+0)**

Course Outcome

After the completion of the course students able to design practical RF MEMS devices using analytical and numerical techniques and high-performance circuits and sub-systems using RF MEMS components.

Syllabus: RF MEMS relays and switches. Switch parameters. Actuation mechanisms. Bistable relays and micro actuators. Dynamics of switching operation. MEMS inductors and capacitors. Micromachined inductor. Effect of inductor layout. Modeling and design issues of planar inductor. Gap tuning and area tuning capacitors. Dielectric tunable capacitors. Micromachined RF filters. Modeling of mechanical filters. Electrostatic comb drive. Micromechanical filters using comb drives. Electrostatic coupled beam structures.

MEMS phase shifters. Types. Limitations. Switched delay lines. Micromachined transmission lines. Coplanar lines. Micro machined directional coupler and mixer. Micromachined antennas. Microstrip antennas – design parameters. Micromachining to improve performance. Reconfigurable antennas.

Reference Book

1. V.K.Varadan etal, RF MEMS and their Applications, Wiley.

ECE 535 **Computer Communications** **Credits: 3(3+0)**

Course Outcome

In this course students are able to understand and analyze the issues with host naming, addressing, and routing packets in networks-of-networks (internetworks). They are capable to develop a simple network simulator to analyze the TCP protocol performance under limited network resources. And also understand why wireless networks are different from wired, and to analyze the issues with internetworking of wired and wireless mobile networks.

Syllabus: Study of function TCP/IP ref. Model in computer networks. Switching techniques & Switches, Broad band ISDN & ATM. Polling techniques, multiplexing & concentration, LAN components, transmission media used in physical layer, X.25 networks. Queuing theory, Max. Flow Algorithm, Introduction to LAN, WAN, LAN protocols, ALOHA, IEEE standards for LAN. High speed fiber optic networks, FDDI, SONET satellite networks, packets radio networks. Data link layer protocols, error detection & correction codes in DLL. Protocol performance evaluation, protocol specification & verification, Routing and congestion in network layer, routing & congestion control algorithms. Network layer in Internet and ATM networks. Network synchronization, traffic analysis, Network management in routing control. Connection management in transport layer. Protocols of transport layer. Internet transport protocols like TCP, UDP etc. ATM protocols. Data security & cryptography techniques, access management in application layer, World Wide Web, e-mail, concept of virtual terminals. Study of different computer networks.

Reference Book

1. Computer Network, Tanenbaum, P.H..I publication.
2. Data and Computer Communication : William Stalling.
3. Computer and internet, by Comer, McGraw Hill.

SUPPORTING COURSES

BS 514 **Optimization Techniques** **Credits: 3(3+0)**

Course Outcome

After the completion of course they also able to develop hybrid methods to solve the complex real time problems will be able to get awareness about the real world problems, their understanding and ability to formulate mathematical models of these problems. For example: Finance, Budgeting, Investment, Agriculturist, Transportation, Cable network, Traveling salesman and many more such problems.

Syllabus: Introduction: Historical development, application to engineering problems, statement of optimization, classification of optimization, examples of optimization problems. Optimization: Calculus based methods, Lagrange multiplier.

Non-Linear Programming: Unconstrained optimization techniques, Constrained optimization, direct and indirect methods, Kuhn-tucker conditions.

Linear Programming: Graphical method, simplex method, revised simplex method, Big-M method, 2-phase method, unbounded LPs, degeneracy and convergence, Duality in linear programming, sensitivity analysis, dual simplex method.

Transportation Problem: North-west corner Rule, Row-minimum method, Vogel's Approximation.

Dynamic Programming: Multistage decision process, principles of optimality, computational procedures in dynamic programming.

Reference Books

1. S. S. Rao *Engineering optimization – Theory and practice*, New Age International (P) Ltd, New Delhi.
2. H. Taha *Operation research: An introduction*, Prentice Hall, India.

BS 515 **Higher Mathematics** **Credits: 3(3+0)**

Course Outcome

This course Motivate and challenge learners by enabling them to select and apply mathematical techniques in a variety of mathematical situations also give idea how to develop confidence in the subject and a positive attitude towards further study in mathematics and the use of mathematics in employment.

Syllabus: Complex Variables: Analytic functions; Cauchy-Riemann equations; Harmonic functions; Construction of analytic functions. Conformal mapping: Elementary transformations; Bilinear mapping. Complex integration: Cauchy's integral theorem; Cauchy's integral formula and derivatives

of an analytic function. Taylor's and Laurent's series. Classifications of singularities; Residue of functions, Cauchy's residue theorem; Evaluation of real integrals by means of calculus of residue.

Special Functions: Error function, Fresnel integrals, Sine and Cosine integrals. Bessel function; Bessel's differential equation, recurrence relations, orthogonal property and generating function. Legendre Polynomials; Legendre differential equation, Rodringue's formula, recurrence relations, orthogonal property and generating function.

Reference Books

1. G.N. Purohit and S.P. Goyal, Complex Analysis, Jaipur Publishing House, Jaipur.
2. B.S. Tyagi, Functions of Complex Variables, Kedarnath Ramnath, Meerut.
3. J.L. Bansal and H.S. Dhami, Differential Equations (Vols.-II), Jaipur Publishing House, Jaipur.
4. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics (II Edition), Narosa Publishing House, New Delhi.

CSE 513 Embedded System Design Credits: 3(3+0)

Course Outcome

After completion of course work students will be able to Complete design of an embedded system with functional requirements for hardware and software components including processor, networking components, and sensors, along with applications, subsystem interfaces, networking, and middleware.

Syllabus: Design challenges, processor, technology, IC technology, design technology. Custom single purpose processor: custom single purpose processor design, operation, programmer view, development environment, application specific instruction set processor, selecting a microprocessor.

Standard single purpose processor peripherals, timers counters, watchdog timers, UART, pulse with modulator, LCD controller, keypad controller, APC, real time clocks. Memory: memory write ability and storage performance. Common memory types, composing memories, memory hierarchy and cache, advanced RAM: DRAM, FPMDRAM, EDO DRAM, SDRAM, RDRAM, Memory management unit.

Interfacing: arbitration, multi-level bus architectures, serial protocols: 12C bus, CAN bus, Fire Wire Bus, USAB, parallel protocols: PCI and ARM Bus, wireless protocols: 1rdA, Bluetooth, IEEE 802.11.

Control systems: open loop and closed loop systems, general control systems and PID controllers, fuzzy control, practical issues related to computer based control, benefits of computer based control implementations.

Reference Books

1. Frank Vohid and Tomy Givargi. Embedded System Design: A Unified Hardware/software Introduction, wiley.
2. Raj Kamal. Embedded System: Architecture, Programming and Design, Tata McGraw-Hill Publication.

BS 611 Numerical Analysis of Differential Equations Credits: 3(3+0)

Course Outcome

After completion of course work students will be able to derive appropriate numerical methods to solve algebraic and transcendental equations, to approximate a function, methods to solve a differential equation, to evaluate a derivative at a value and to solve a linear system of equations

Syllabus: Numerical solution of Ordinary Differential Equations: Single step methods: Taylor's series method, Picard's method, Euler's and Euler's modified method, Runge-Kutta methods. Multi-step methods: Milne's method, Adams-Moulton method. System of simultaneous and higher order differential equations. Convergence and stability analysis.

Partial Differential Equations: Classification of linear second order equations, Finite difference methods for the solution of two-point boundary-value problems and eigenvalue problems. Elliptic, parabolic and hyperbolic partial differential equations.

Reference Books

1. Babu Ram, *Numerical Methods*, Pearson Education India.
2. Santosh K. Gupta, *Numerical Methods for Engineers*, New Age International Publishes, New Delhi.
3. Dileep S. Chouha, Paresh Vyas & Vimlesh Soni, *Studies in Numerical Analysis*, Jaipur Publishing House, Jaipur.
4. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering computation*, New Age International (P) Ltd, New Delhi.

CSE 523 Advance Network Security Credits: 3 (2+1)

Course Outcome

After completion of course work students will be able how to familiarity with information security awareness and a clear understanding of its importance and also become familiar with how threats to an organization are discovered, analysed, and dealt with.

Syllabus: Principle of security, types of attacks, cryptography techniques: plain text and cipher text, substitution techniques, transposition techniques, encryption & decryption, symmetric & asymmetric cryptography, steganography, key range and key size, possible types of attacks.

Computer based symmetric key cryptography algorithms: symmetric key cryptography, DES, IDEA, blowfish, advance encryption standards, computer- based asymmetric key cryptographic algorithms: RSA algorithms, digital Signature, MD5, discrete logarithm algorithms.

Public Key Infrastructure (PKI): digital certificates, private key management, authentication password, authentication tokens, certificate based authentication, biometric authentication, kerberos, single sign on (SSO).

Internet Security Protocols: secure socket layer, secure hyper text transfer protocol, time stamping protocol, secure electronic transaction, electronic money, E-mail security, wireless application protocol (WAP) security, Network Security: IP security, firewalls, virtual private networks, denial of service attack, IP spoofing attacks, cross site scripting vulnerability, contract signing, secret splitting, virtual elections. Intrusion detection, models, architecture, NIDS, HIDS, network security, network security attacks, applications of cryptography in network security, encryption at different OSI-layers, code based vulnerabilities, policy deployment in network, study of emerging intrusion detection and prevention techniques.

Reference books

1. Atul Kahate. Cryptography and Network Security, Tata McGraw-Hill Publishing Company Ltd.
2. William Stallings. Cryptography and Network Security, Pearson Asia.
3. Bishop and Matt. Introduction to Computer Security**,** Addison-Wesley, Pearson Education, Inc.

CSE 527 **Soft Computing** **Credits: 3(2+1)**

Course Outcome

In this course students will able to learn about soft computing techniques and their applications, Analysis of various neural network architectures and also understand perceptrons and counter propagation networks.

Syllabus: Essentials of artificial neural networks & applications, characteristics of artificial neural network biological prototype, perceptron, multilayer neural network. Learning methods, back propagation, counter propagation, ART, BAM, associative memories.

Fuzzy logic, fuzzy sets, fuzzy model, fuzzy rule generation, fuzzy inference system, defuzzification. neuro fuzzy systems, architecture and application of a neuro fuzzy system and its applications.

Genetic Algorithm: problem solving using GA, applications of GA & GP, hybrid systems.

Reference Books

1. Jang.Neuro fuzzy and soft computing,Pearson Education.
2. Kecman. Learning and Soft Computing, Pearson Education.
3. Klir and Yuan. Fuzzy Sets and Fuzzy Logic, PHI.
4. Fu. Neural Network in computer Intelligence, TMH.
5. Bart Kosko. Neural Networks and Fuzzy Systems, PHI.
6. Melaine Mitchell. An Introduction to Genetic Algorithm, PHI Course.

BS 521 **Methods of Numerical Analysis** **Credits: 3(3+0)**

Course Outcome

In this course students will able to develop methods to solve the numerical approximation and solution of scientific problems such as simple optimisation, clustering , polynomial and spline interpolation, methods for pattern recognition, integration and differentiation, solution of large scale systems of linear and nonlinear equations, modelling and solution with sparse equations; explicit schemes to solve ordinary differential equations.

Syllabus: Solution of system of linear equations: Gaussian elimination method, Gauss-Jordan method, Gauss-Seidel method, matrix inversion method. Matrix Eigenvalue problem: Power method and inverse power method.

Numerical solution Ordinary Differential Equations: Taylor's series method, Picard's method, Euler's and Euler's modified method, Runge-Kutta methods.

Solution of Algebraic and Transcendental Equations: Bisection method, False position method, Newton Raphson method.

Interpolation: Forward, backward and central difference operators, Shifting and Averaging operator, relation between difference operators. Forward and backward interpolation formulae, Lagrange's interpolation formula for unequal intervals. Solution of difference equations: Linear difference equations, different forms of particular solutions.

Reference Books

1. Babu Ram, *Numerical Methods*, Pearson Education India.
2. Santosh K. Gupta, *Numerical Methods for Engineers*, New Age International Publishes, New Delhi.
3. Dileep S. Chouha, Paresh Vyas & Vimlesh Soni, *Studies in Numerical Analysis*, Jaipur Publishing House, Jaipur.
4. S.S. Sastry: Introductory Methods of Numerical Analysis, Prentice Hall Pvt. Ltd.
5. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering computation*, New Age International (P) Ltd, New Delhi.

BS621 **Advanced Mathematics for Computing** **Credits: 3(3+0)**

Course Outcome

In this course students get the knowledge of matrix computations by solutions of linear equation for non homogeneous systems various methods such as direct method, Gaussian elimination method, gauss Jordan method Etc.

Syllabus: Matrix Computations: Solutions of non-homogenous system of linear equations: Direct methods: Matrix inversion method, Gaussian elimination method, Gauss-Jordan method, LU

decomposition method. Iterative methods: Jacobi method, Gauss-Seidel method, the Relaxation method. Matrix Eigenvalue problem: Power method, Jacobi method, Given's method.

Curve fitting and Approximation Theory: Least square principle for linear and non-linear data. Least square approximation using orthogonal polynomial. Chebyshev approximation, Chebyshev polynomial, Chebyshev expansions.

Fast Fourier Transform: Discrete Fourier transform, Fast Fourier transform.

Reference Books

1 A.K. Gupta & S.K. Sarkar, *Mathematics for Computing*, Wheeler Publishing, New Delhi.

2 Babu Ram, *Numerical Methods*, Pearson Education India.

3 Santosh K. Gupta, *Numerical Methods for Engineers*, New Age International Publishes, New Delhi.

4 Dileep S. Chouha, Paresh Vyas & Vimlesh Soni, *Studies in Numerical Analysis*, Jaipur Publishing House, Jaipur.

Note:

1. For supporting courses course description, which are offered by other departments, refer separately syllabus of that particular department.
2. For syllabus of Non-Credit Compulsory Courses, see at the end.

❑❑❑

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

To provide mechanical engineers of highest caliber who would engage in research, design and development to help building the nation towards self-reliance in her technological need and to become a centre of excellence in education, research and technological service to the nation for its need in design and manufacturing independence.

MISSION

- To promote academic growth in the discipline of mechanical engineering by offering state-of-the-art undergraduate, postgraduate and doctoral programmes.
- To arm the graduates with latest technologies and knowledge of applying them for finding technically feasible and economically viable solutions of the problems of manufacturing sector and to make them globally competitive.
- To create an ambience of academic excellence in which new ideas, research and entrepreneurship flourish and from which the leaders and innovators of tomorrow emerge.

Programme Educational Objectives

PEO 1: To prepare students for successful careers in industry that meet the needs of Indian and multinational companies

- PEO 1.1 Placement
- PEO 1.2 Progress in professional career

PEO 2: To develop the ability among students to synthesize data and technical concepts for application to product design

- PEO 2.1 Analyse real life problem
- PEO 2.2 Design and develop economically feasible and socially acceptable Computing Solutions

PEO 3: To provide opportunity for students to work as part of teams on multidisciplinary projects.

- PEO 3.1 Professional conduct
- PEO 3.2 Interpersonal skills

PEO 4: To provide students with a sound foundation in the advanced mathematical, scientific and engineering fundamentals & techniques necessary to formulate, solve and analyze engineering problems and to prepare them for careers in R&D and in academics.

- PEO 4.1 Research
- PEO 4.2 Higher education

PEO 5: To promote student awareness of the life-long learning and to introduce them to professional ethics and codes of professional practice.

- PEO 5.1 Adapting to current trends in technology
- PEO 5.2 Socially responsible and ethical practices

Programme Outcome

1. Graduates will demonstrate basic knowledge in mathematics, science and engineering.
2. Graduates will demonstrate the ability to design and conduct experiments, interpret and analyze data and report results.
3. Graduates will demonstrate the ability to design a mechanical system or a thermal system or a process that meets desired specifications and requirements.
4. Graduates will demonstrate the ability to function on engineering and science laboratory teams, as well as on multidisciplinary design teams.
5. Graduates will demonstrate the ability to identify, formulate and solve mechanical engineering problems.
6. Graduates will demonstrate an understanding of their professional and ethical responsibilities.
7. Graduates will be able to communicate effectively in both verbal and written forms.
8. Graduates will have the confidence to apply engineering solutions in global and societal contexts.
9. Graduates should be capable of self-education and clearly understand the value of lifelong learning.
10. Graduates will be broadly educated and will have an understanding of the impact of engineering on society and demonstrate awareness of contemporary issues.
11. Graduates will be familiar with modern engineering software tools and equipment to analyze mechanical engineering problems.

Semester-wise Scheme for Post Graduate Programme in Mechanical Engineering

Details of courses offered for the award of M.Tech. (CAD/CAM) in Mechanical Engineering

Course Title	Course No.	Credit Hours	Semester			
			I	II	III	IV
Core Courses: Total 12 Credits; two courses in first semester (6 credits) and 2 courses in the second semester (6 credits) to be evaluated externally						
Finite Element Method	MED511	3(2+1)	3(2+1)			
Computer Integrated Manufacturing	MED512	3(2+1)	3(2+1)			
Metal Cutting And Removal Processes	MED513	3	3			
Computer Aided Design	MED521	3(2+1)		3(2+1)		
Dynamics of Machines	MED522	3(2+1)		3(2+1)		
Work Analysis And Work Measurement	MED523	3		3		
Optional (Major) Courses: Total 15 Credits; two courses each in first and second semesters (6 credits in each semester) and one course in the third semester (3 credits)						
Stress Analysis	MED514	3	3			
Manufacturing Automation	MED515	3	3			
Ergonomics And Work Design	MED516	3	3			
Major Elective-I (*any one from list*)	MED524	3		3		
Major Elective-II (*any one from list*)	MED525	3		3		
Major Elective-III (*any one from list*)	MED531	3			3	
Minor & Supporting Courses: Total 9 credits; one course in first, second and third semester each (3 credits in each semester).						
Computational Method & Programming	MED517	3(2+1)	3			
Total Quality Management	MED518	3	3			
Computer Aided Modelling and Analysis	MED526	3(2+1)		3(2+1)		
Reliability And Maintenance Engineering	MED527	3		3		
Minor Elective (*any one from list*)	MED532	3			3	
Others						
Compulsory Courses; {(0+1) or (1+0)} Non Credit (NC); PGS Series	PGS501/502/...	1	NC	NC		
Seminar (0+1)	MED533	1	-	-	1	-
Comprehensive	MED534	NC			NC	
Research (Thesis). Thesis minimum duration 2 semesters	MED535	20	-	-	-	20
Total credits to be offered (for Master Programme)		**57**	**15**	**15**	**7**	**20**

COURSE SUMMARY

Courses	No. of Courses					Credit Hours
	Semester					
	I	II	III	IV	Total	
Core	2	2	-	-	4	12
Optional (Major)	2	2	1	-	5	15
Minor & Supporting	1	1	1	-	3	9
Seminar	-	-	1	-	1	1
Comprehensive	-	-	-	1	1	Non Credit (graded as satisfactory/non satisfactory)
Research (Thesis)	-	-	-	1	1	20* (graded as satisfactory/ non satisfactory)
Compulsory Courses (PGS Series)	1	1	-	-	2	Non Credit
Total	**6**	**6**	**3**	**2**	**17**	**57**

*Research (Thesis) credit load is not counted in calculation of final OGPA.

Details of courses offered for the award of Ph.D. (Mech.) in Mechanical Engineering

Subject	Course No.	Credits	Semester			
			I	II	III	VI-VI
Core Courses: Total 6 Credits; one courses in first semester (3) credits) and one courses in the second semester (3 credits) to be evaluated externally						
Finite Element Method	MED511	3(2+1)	3(2+1)			
Computer Integrated Manufacturing	MED512	3(2+1)	3(2+1)			
Metal Cutting And Removal Processes	MED513	3	3			
Computer Aided Design	MED521	3(2+1)		3(2+1)		
Dynamics of Machines	MED522	3(2+1)		3(2+1)		
Work Analysis And Work Measurement	MED523	3		3		
Heat Transfer	ME611	3	3			
Metal Working	ME621	3		3		
Optional (Major) Courses: Total 12 credits; (6 credits in each semester) two courses in first and second semester each						
Stress Analysis	MED514	3	3			
Manufacturing Automation	MED515	3	3			
Ergonomics And Work Design	MED516	3	3			
Major Elective-I (*any one from list*)	MED524	3		3		
Major Elective-II (*any one from list*)	MED525	3		3		
Major Elective-III (*any one from list*)	MED531	3			3	
Internal Combustion Engines	ME612	3	3			
Value Engineering	ME613	3	3			
Direct Energy Conversion	ME614	3	3			
Applied Refrigeration	ME622	3		3		
Combustion Engineering	ME623	3		3		
Minor & Supporting Courses: Total 9 credits, two courses in first semester (6 credits) and one course in second semester (3 credits)						
Computational Method & Programming	MED517	3(2+1)	3			
Total Quality Management	MED518	3	3			
Computer Aided Modelling and Analysis	MED526	3(2+1)		3(2+1)		
Reliability And Maintenance Engineering	MED527	3		3		
Minor Elective (*any one from list*)	MED532	3			3	
Value Engineering And Productivity	ME615	3	3			
Air-Conditioning	ME616	3	3			
Refrigeration Engineering	ME624	3		3		
Others						
Compulsory Courses+; {(0+1) or (1+0)} Non Credit (NC); PGS Series	PGS501/502/...	1	NC	NC		
Seminar	ME 691/ 692	1 (0+1)	1	1	-	-
Preliminary	ME634	NC			NC	
Research (Thesis). Thesis minimum duration 4 semesters	ME635	45	-	-	-	45
Total credits to be offered		**74**	**16**	**13**	**-**	**45**

Note: A Ph.D. student must take two 600 series core courses but may also take 500 series courses if not studied during Masters Programme as per ICAR guidelines.

\+ Exempted for those who have cleared these in Master's Programme (permission to be sought from the Dean, CTAE).

COURSE SUMMARY

Courses	No. of Courses							Credit Hours
	Semester							
	I	II	III	IV	V	VI	Total	
Core	1	1	–	–	–	–	2	6
Optional	2	2	–	–	–	–	4	12
Minor & Supporting	2	1	–	–	–	–	3	9
Seminar	1	1	–	–	–	–	2	2
Preliminary	–	–	1	–	–	–	1	Non Credit (graded as satisfactory/ non satisfactory)
Research (Thesis)	–	–	–	–	–	1	1	45* (graded as satisfactory/ non satisfactory)
Compulsory Courses** (PGS Series)	1	1	–	–	–	–	2	Non Credit
Total	**7**	**6**	**1**			**1**	**15**	**74**

*Research (Thesis) credit load is not counted in calculation of final OGPA.

**Exempted for those who have cleared these in Master's Programme.

List of Major Electives

Major Elective-I	
MED524(a)	Manufacturing Systems & Simulation
MED524(b)	Manufacturing Planning & Control
MED524(c)	Sheet Metal Working
MED524(d)	Quality Control and Industrial Inspection
Major Elective-II	
MED525(a)	Facilities Planning and Plant Engineering
MED525(b)	Product Design & Development
MED525(c)	Optimization Methods in Engineering
MED525(d)	Robotics
Major Elective-III	
MED531(a)	Design of Material Handling Equipment
MED531(b)	Machine Tool Design
MED531(c)	Design For Fatigue and Fracture
MED531(d)	Materials Management

List of Minor Electives

MED532(a)	Concurrent Engineering
MED532(b)	Design of Heat Transfer Equipment
MED532(c)	Materials Technology
MED532(d)	Non Traditional Machining Processes
MED532(e)	Maintenance Management

CORE COURSES

MED511 Finite Element Method

	L	T	P
Credit	2	0	1
Hours	2	0	2

Mathematical preliminaries, vectors, matrices, etc. Review of theory of elasticity, stress-strain relations, strain-temperature relations, plane stress, plane strain, axisymmetric case.

Direct or stiffness formulation of FEM. Element stiffness matrix, assembly, imposition of boundary conditions, solution of global system, stress and support reaction computation. Computation details, storage of global matrices.

Principle of stationary potential energy, principle of virtual work. Variational formulation of FEM. Rayleigh-Ritz method. weighted residuals and Galerkin method. Piecewise polynomial interpolation. Shape functions, degree of continuity. Shape functions for C^0 and C^1 elements. Lagrangian and Hermite interpolations.

Displacement based formulation for structural problems. Elemental matrices, consistent element nodal loads, lumping of loads. Equilibrium and compatibility in FE model. Convergence requirements. Bar, beam, frame, CST, plane bilinear and plane quadratic elements. Natural (linear, area and volume) coordinates. Coordinate transformations.

Isoparametric formulation. Isoparametric bar, beam, plane bilinear and quadratic elements. Isoparametric triangular elements. Consistent load vector. Numerical integration, Gauss quadrature. Jacobian matrix. Subparametric and superparametric elements.

FE formulation for dynamic and vibration problems. Consistent and lumped mass matrix, lumping schemes. Damping matrix. Eigenvalue problem, mode shapes and natural frequencies.

Solution of equations in static analysis. Gauss elimination, LDL^T factorisation. Computational aspects. Introduction to frontal method of solution. Introductory concepts of condensation, incompatible elements, hybrid formulations, higher order elements, singularity elements, substructuring, reanalysis, symmetry considerations.

Applications of FEM to engineering mechanics, stress analysis, fluid flow and heat transfer problems.

Practicals

Practice on FEA softwares available in lab.

Texts/References

1. T.R. Chandrupatla and A.D. Belegundu: Introduction to Finite Elements in Engineering, PHI, New Delhi.
2. R.D. Cook, D.S. Malkus and M.E. Plesha: Concepts and Applications of Finite Element Analysis, John Wiley.
3. K.J. Bathe: Finite Element Procedure, Prentice Hall of India.
4. C.S. Desai and J.F. Abel: Introduction to Finite Element Method, Affiliated East-West Press.

MED512 Computer Integrated Manufacturing

	L	T	P
Credit	2	0	1
Hours	2	0	2

Computer-integrated manufacturing: Types of manufacturing systems, machine tools and related equipment, material handling system, benefit of CIMS.

Introduction to numerical control, basic components of NC system, Problems with conventional NC, computer numerical control, direct numerical control, adaptive control machining systems.

NC coordinates and motion control systems, punched tape in NC, tape coding and format. Manual and computer assisted part programming, simple exercise in APT language.

Group technology: Part families, parts classification and coding systems, group technology machine cells, benefits of group technology.

Flexible manufacturing systems: Introduction, components of FMS, application work stations. Computer control and functions - planning, scheduling and control of FMS, knowledge based scheduling.

Computer aided process planning, process planning function CAPP. Computer generated time standards.

Computer monitoring: Types of production monitoring systems-structure model of manufacturing process-process control & strategies direct digital control-supervisory computer control-computer in QC, contact inspection methods non-contact inspection method, computer-aided testing, integration of CAQC with CAD/CAM.

Practicals

Study of pneumatic and hydraulic actuation systems; programming in G & M codes; practice on automated programming softwares in lab; job on CNC machines available in lab.

Texts/References

1. M.P. Groover and E.W. Zimmers: CAD/CAM- Computer Aided Design and Manufacturing, Prentice-Hall of India, New Delhi.
2. T.K.Kundra, P.N. Rao and N.K. Tewari: Numerical Control and Computer Aided Manufacturing, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
3. Surendra Kumar and A.K. Jha: Technology of Computer Aided Design and Manufacturing CAD/CAM, Dhapat Rai & Sons, Delhi.
4. A.S.T.M.E.: Manufacturing by Numerical Control Handbook, ASTME, U.S.A.
5. S. Krar and A. Gill: CNC Technology and Programming, McGraw Hill.
6. D. Gibbs: An Introduction to CNC Machining, Casell.
7. W.S. Seames: Computer Numerical Control Concepts and Programming, Delmar Publishers.
8. M. Lynch: Computer Numerical Control for Machining, McGraw Hill.

MEP513 Metal Cutting and Removal Processes

	L	T	P
Credit	3	0	0
Hours	3	0	0

Orthogonal and Oblique cutting: Chip formation, Force and shear angle relationship, thin zone models, oblique cutting, cutting geometry, geometry of turning, milling and drilling tools, shear angle, velocity relationships. Force and stress relationship, dynamometry, types of dynamometers, design features of dynamometers of turning, milling and drilling processes.

Friction and thermal aspects: Friction processes in metal cutting, action of cutting fluids, cooling effect, reduction of friction, tool life and shear strength of work material, application and selection of cutting fluids. Source of heat generation and temperature distribution in the cutting zone, dimensional analysis. Measurement of cutting temperature.

Tool wear and Machineability: Mechanism of tool wear, adhesion, abrasion, diffusion and fatigue, wear rate, tool life criteria, factors affecting tool life, testing of tool life. Machineability criteria; machining cost, criteria for optimisation, cutting speeds for minimum cost of production and maximum production rate, restriction for selecting economical conditions.

Abrasive machining processes: Mechanics of surface and cylindrical grinding, performance of grinding, honing and lapping operations, basic principles and mechanics of metal removal in abrasive, water-jet, ultrasonic machining. Variables governing the process, economic considerations, application and limitation.

Texts/References

1. A. Bhattacharya: Metal Cutting Theory and Practice, New Central Book Agency.
2. G. Boothroyd, Fundamentals of Metal Machining and Machine Tools, McGraw Hill Book Co.
3. P.L.B. Oxley: The Mechanics of Machining, Ellis-Harwood.
4. M.C. Shaw: Metal Cutting Principles, Oxford.
5. J. McGeough: Advanced Methods of Machining, Chapman and Hall.

MED 521 Computer Aided Design

	L	T	P
Credit	2	0	1
Hours	2	0	2

Design process, application of computers for design, definition of CAD, benefits of CAD. CAD system components. Computer hardware for CAD. Display, input and output devices.

Computer Graphics: Graphics primitives, display file, frame buffer, display control, display processors. Line generation, graphics software. Points and lines and other primitives. Homogeneous coordinates. Transformations. Planar and space curves design. B-spline and Beizer curves. Geometric modelling techniques. Wire frames. Introduction to solid modelling.

Recent developments in design techniques, optimum design, diagnosis and prognosis of component failures, fatigue design, reliability, design for production and assembly, developments in existing design performance and testing.

Optimisation methods in design. General techniques, exact and iterative techniques. Optimal design of elements and systems. Role of optimisation techniques and finite element method in CAD.

Practicals

Practicals will be based on modelling and analysis of machine components using available software.

Texts/References

1. D.F. Rogers and A. Adams: Mathematical Elements for Computer Graphics, McGraw Hill Inc., New York.
2. I.D. Faux and M.J. Pratt: Computational Geometry for Design and Manufacture, John Wiley & Sons, NY.
3. Steven Harrington: Computer Graphics- A Programming Approach, McGraw Hill.
4. M.P. Groover and E.W. Zimmers: CAD/CAM - Computer Aided Design and Manufacturing, Prentice-Hall of India, New Delhi.
5. Surendra Kumar and A.K. Jha: Technology of Computer Aided Design and Manufacturing CAD/CAM, Dhapat Rai & Sons, Delhi.

MED 522 Dynamics of Machines

	L	T	P
Credit	2	0	1
Hours	2	0	2

Review of kinematic analysis: Mobility, displacement, velocity and acceleration analysis. Analytical methods using complex algebra and vector approaches. Chace solutions.

Synthesis: Types of synthesis, function generation, path generation and body guidance. Chebychev spacing. Coupler curve synthesis. Roberts-Chebychev theorem. Bloch's method of synthesis. Fruendenstein's equations. Analytical synthesis using complex algebra.

Free damped and damped vibrations of single degrees of freedom system. Forced vibrations. Response to periodic excitation, Fourier series. Impulse and step response. Response to arbitrary excitation, convolution integral. System response by Laplace transformation method, transfer function. Vibration isolation and transmissibility.

Multi Degrees of freedom Systems: Equations of motion, coupling and coordinate transformation, principal modes, orthogonality of modes, mode shapes, modal matrix. Response to initial excitation, modal analysis. Influence coefficients, matrix method, Lagrange equations. Vibration absorbers.

Continuous Systems: Discrete vs. continuous systems. Concepts of boundary value problem, free vibration as eigenvalue problem, eigenfunctions or natural modes, orthogonality. Vibrations of

strings, bars, beams and plates, torsional vibrations of shafts. Vibration of beams- effect of rotary inertia and shear deflection, elastic stability. Variational principles and Hamilton's equations, Lagrange's equation.

Approximate and numerical method for multi degrees of freedom systems- Rayleigh's method, Dunkerley's method, Stodola's method and Holzer's method.

Vibration exciters and pickups. Introduction to advanced vibration analysis, signal analysis techniques. Introduction to self-excited, shock and random vibrations.

Practicals: Experiments/exercises on computer aided kinematic, dynamic analysis and synthesis of mechanisms; experiments on vibration measurements and analysis.

Texts/References

1. Joseph E. Shigley and John J. Uicker, Jr.: Theory of Machines and Mechanisms (International Edition), McGraw Hill Inc.
2. H. H. Mabie and C.F. Reinholtz: Mechanisms and Dynamics of Machinery. John Wiley & Sons.
3. G. Sandor and A.G. Erdman: Advanced Mechanism Design Vol.1 & 2, PHI.
4. K.S. Fu, R.C. Gonzalez, C.S.G. Lee: Robotics, McGraw Hill.

MED 523 Work Analysis and Work Measurement

	L	T	P
Credit	3	0	0
Hours	3	0	0

Introduction: Definition, Scope and History of Motion and time study, Work Methods design-Process and operation analysis. Micro-motion and mini-motion study.

Work Measurement and Techniques: Stop watch study, Performance rating methods. Allowances personal. Process. Fatigue and machine interference work sampling.

Pre-determined Time System: Work Factor system. Method Time Measurement (MTM). Basic Motion Studies. Standard data system.

Advanced Study of Topics in Works System Design: Physiological and other aspects of work design, Application of Physiological techniques of work measuring, problems, Fatigue.

Analysis and Evaluation: Current work Measurement. Techniques and Means of reducing and controlling such errors, Application of control charts, Regression analysis and other statistical techniques to work measurement problems.

Text/References

1. R.M. Barnes: Motion & Time Study Design and Measurement of Work, John Wiley and Sons.
2. A. Abruzzi: Work Measurement, Columbia University Press, NY.
3. B.L. Hansen: Work Sampling for Modern Management, Prentice Hall
4. S.M. Lowry, H.B. Maynard and G.J. Stegemerten: Time and Motion Study, MGH.
5. B.W. Niebel: Motion and Time Study, Homewood.

ME 611 Heat Transfer

	L	T	P
Credit	3	0	0
Hours	3	0	0

Conduction: General heat conduction differential equation in rectilinear, cylindrical and spherical Coordinates. Straight fins of rectangular, triangular and trapezoidal sections, effectiveness of fins.

One-dimension steady state conduction with internal heat generation, local heat source in a non-adiabatic plate, thermo-couple conduction error.

Two-dimensional steady state conduction, semi-infinite and finite flat plate, temperature field in infinite and finite cylinders, conduction through spherical shells, graphical methods, numerical methods.

Unsteady state conduction, sudden changes in the temperature of infinite plates, cylinders and other semi-infinite bodies, solutions using Grover's and Heisler's charts.

Convection: Review of continuity and momentum, differential equations for incompressible fluids, differential equation of energy momentum and thermal boundary layers, convective heat transfer coefficient, local and integrated values, Nusselt and Stanton numbers.

Heat transfer in laminar flow, free convection between parallel plates, forced internal flow through circular tubes, fully developed flow, velocity and thermal entry lengths, solutions with constant wall temperature and with constant heat flux; forced external flow over flat plate, the two dimensional velocity and temperature boundary layer equations, the Karman-Pohlhausen approximate integral method.

Heat transfer in turbulent flow, eddy heat diffusivity, Reynolds analogy between skin friction and heat transfer.

Prandtl, Taylor, Von Karman, Maritnelii analogies, turbulent flow through circular tubes.

Radiation: Review of radiation principles, Kirchoff's law, Lambert's cosine law, Planck's Law, Stefan-Boltzmann law, Wien's displacement law.

Radiation through non-absorbing media, Hottel's method of successive reflection, review of methods of analogous electrical circuits, Gabhart's unified method, Polank's method using integral equation shields.

Radiation through absorbing media, logarithmic decrement of radiation, gas radiation, apparent absorptivities of simple shaped gas bodies, net heat exchange between surfaces separated by an absorbing gas, Radiation of luminous gas flames.

Texts/References

1. Holman: Heat Transfer, TMG.
2. E.R.G. Eckerest and R.M. Drake Jr.: Analysis of Heat Transfer, MGH.
3. B. Gebhart: Heat Transfer, MGH.

ME 621 Metal Working

	L	T	P
Credit	3	0	0
Hours	3	0	0

Theory of plasticity: Mohr's circle for two-dimensional and three-dimensional principal stresses, yield criteria, determination of working load, upper bound and lower bound techniques, work hardening, slip line theory and its applications.

Rolling: Determination of roll separating force and rolling torque; design of rolls, camber design, elements of roll pass design, roll materials and treatments

Forging: Determination of compression load for thin strips, low friction and high friction condition, forging of flat circular discs.

Other metal working processes: Analysis of extrusion processes, forward and backward extrusion, analysis of wire drawing processes, analysis of tube sinking, tube expanding and deep drawing.

Friction and lubrication in metal working: Influence of friction in metal working, lubricants used in various metal working process, tools and equipment for metal cutting processes.

Texts/References

1. Society of Mfg. Engineers: Die Design Handbook, SME Publications, Michigan.
2. A.M. Sabaroff et. al: Forging Material and Practices, Reinhold Publishers.
3. C. Pearson: Extrusion of Metals, Wiley.
4. K. Lange: Handbook of Metal Forming, McGraw Hill.
5. W. Johnson and P.B. Mellor: Plasticity for Mechanical Engineers, Van Nostrand.

MAJOR COURSES

MED 514 Stress Analysis

	L	T	P
Credit	3	0	0
Hours	3	0	0

Components of stress and strain, their principal values and invariants. Stress tensor. Stress components along arbitrary plane, state of stress referred to principal axes. Octahedral stresses. Hydrostatic and pure shear states. Mohr's circles for three-dimensional state of stress. State of strain at a point, strain components. Cubic dilation. Principal axes and strains. Strain deviator and its invariants. Plane stress and strain states. Stress-strain relations for linearly elastic solids, generalised Hooke's law, relation between elastic constants.

Differential equations of equilibrium, boundary conditions, compatibility conditions. Equations of equilibrium in cylindrical coordinates, axisymmetric and plane stress. Airy's stress function. Simple 2-D problems, bending, torsion and axisymmetric problems.

Complex variable approach, complex representation of stresses, displacements and applied boundary loads. Different methods of solution of 2-D problems for infinite plates with simply connected regions.

Experimental methods of stress analysis. Strain gauges, photoeleasticity, birefringent coatings, brittle coatings, Moire fringes, X-ray techniques and holography.

Texts/References

1. S.P. Timoshenko and J.N. Goodier: Theory of Elasticity, McGraw Hill, 1982.
2. J.W. Dally and W.F. Riely: Experimental Stress Analysis, McGraw Hill.
3. N.I. Mushelishvili: Some Basic Problems of the Mathematical Theory of Elasticity, Noordhoof, Netherlands.

MED 515 Manufacturing Automation

	L	T	P
Credit	3	0	0
Hours	3	0	0

Product cycle, Manufacturing functions, Types of automation, Degree of automation, Technical, economic and human factors in automation, Technologies- Mechanical, Electrical, Hydraulic, Pneumatic, Electronic, Hybrid systems, Comparative evaluation.

Development of small automation systems using mechanical devices, Basics pneumatics, Synthesis of circuits, Basics of hydraulic systems, Synthesis of hydraulic circuits, Elements used for electrical circuits, Synthesis, Circuit optimization techniques.

Illustrative examples of the above types of systems as well as hybrid systems used for automation of working cycles of machines, Material Handling, Inspection and Assembly.

Industrial logic control systems, Logic diagramming, Programmable controllers, Applications, designing for automation, Cost-benefit analysis.

Texts/References

1. A.N. Gavrilov, Automation and Mechanisation of Production Process in Instrument Industry, Pergaman Press, Oxford.
2. G. Pippengerm, Industrial Hydraulics, MGH, New York.
3. F. Kay, Pneumatics for Industry, The Machining Publ. Co., London.
4. Asfhal Ray, Robots and Manufacturing Automation, John Wiley, New York.
5. G. Boothroyd, C. Poli, Automatic Assembly, Marcel Dekkar, New York.

MED 516 Ergonomics and Work Design

	L	T	P
Credit	3	0	0
Hours	3	0	0

Introduction: Definition and brief history, aims, ergonomics as Multidisciplinary approach to industrial problems, industrial change.

Physical basis of perception: His environmental; metabolism and heat regulation; dynamic and static anthropometry; nervous system and psychosensorial processes; measurement of work and work capacity.

Environmental Ergonomics: Mechanical environment, perceptual environment, thermal and other ambient environment. Design of Equipment and Work place, visual and auditory displays, console design and panel layout, work place envelope and work place arrangement.

Individual in the Work: Organization; motivation to work studies of the nature of man at work; developing effective social systems for work.

Ergonomics for Accident Prevention Systems Ergonomics: Introduction to the systems approach, analysis of dynamic systems, man management and administrative systems, systems analysis and design.

Text/References

1. E.J. McCormic, Human Factors in Engineering Design, TMG.
2. O.P. Astrand and R. Kaare, Text Book of Work Physiology, McGraw Hill.
3. R.D. Huchingson, New Horizon for Human Factors Design, McGraw Hill.

MED 524 (MAJOR ELECTIVE – I)

MED524(a) Manufacturing Systems & Simulation

	L	T	P
Credit	3	0	0
Hours	3	0	0

Computer modelling and simulation systems: Monte Carlo simulation, Nature of computer modelling and simulation. Limitation of simulation, areas of application.

Components of a system- discrete and continuous systems. Models of a system- a variety of modelling approaches.

Random number generation: Techniques for generating random numbers, midsquare method, the mid product method, constant multiplier technique, additive congruential method, linear congruential method, tests for random numbers, the Kolmogorov, Smirnov test, the Chi-Square test.

Random variable generation: Inverse transform technique, exponential distribution, uniform distribution, Weibull distribution. Empirical continuous distribution, generating approximate normal variates, Erlang distribution.

Distribution and evaluation of experiments: Discrete uniform distribution, Poisson distribution, geometric distribution, acceptance rejection technique for Poisson distribution gamma distribution.

Simulation Experiments- Variance reduction techniques, antithetic variables, verification and validation of simulation models.

Discrete event simulation: Concepts in discrete-event simulation, manual simulation using event scheduling, single channel queue, two server queue, simulation of inventory problem.

Programming for discrete event systems in GPSS - Case studies.

Texts/References

1. Jerry Banks and John S. Carson, II, "Discrete Event System Simulation", Prentice Hall Inc. 1984.
2. Gordon G, "Systems Simulation", Pentice Hall of India Ltd., 1991.

MED524(b) Manufacturing Planning and Control

	L	T	P
Credit	3	0	0
Hours	3	0	0

Production Planning: Planning horizons, product exploring, make or buy decisions, operation planning, demand forecasting, conversion of forecast into production goals.

Routing and scheduling: preparation of route sheets, master route sheets, scheduling orders and products, operation sequencing and balancing. Scheduling for mass production and job order production.

Inventory Systems: Cost factors relevant to operations and inventory control, EOQ with shortages and uniform productions, quantity discounts, uncertainty, Interrelationship of operations inventory control of maintenance and repairs items.

Project planning and control: Network control, control cost considerations and optimisation. Resources allocations and levelling. Despatching and follow up as production control procedures.

Aggregate Production planning models: Criteria for effectiveness, Decision rules. Organisation and documentation for PPO, Performance reporting.

Texts/References

1. D.D. Bedworth and J.E. Bailey: Integrated Production Control, System – Management, Analysis and Design, John Wiley.
2. E.A. Elsayed and T.O. Boucher: Analysis and Control of Production Systems, Prentice Hall.
3. J.R. King: Production Planning and Control, Pergamon Press.
4. P.F. Bestwick and K. Lockyer: Quantitative Production Management, Pitman Publications.
5. A.C. Hax and D. Candea: Production and Inventory Management, Prentice Hall.
6. L.A. Johnson and D.C. Montgomery: O.R. in Production Planning, Scheduling and Inventory Control, John Wiley & Sons.
7. M.G. Korgaonkar: JIT in Manufacturing, McMillan Publication Co.

MED524(c) Sheet Metal Working

	L	T	P
Credit	3	0	0
Hours	3	0	0

Sheet metal production, Mechanical properties and their assessment, Forming Limit Diagram (FLD), Anisotropic yield criteria, Stress and strain paths.

Sheet metal forming processes: Shearing, Punching/ Blanking, Bending, Deep drawing, Pre and post treatment of sheet metal parts.

Process modeling & analysis of typical processes, Scope of CAD/CAM in sheet metal forming, Numerical Analysis of forming processes.

Forming Machines: Conventional and Advanced CNC shears, Press brakes, Turret punching press etc., Sheet handling equipment.

Tool design & Design of inspection fixtures, Component handling, Super plastic forming.

Practicals: Development of surfaces, Design of dies, tools and fixtures.

Text/References

1. American Soc. for Metals: Metals Handbook (10th Edition, Vol. 15 on Metal Forming), ASM.
2. David, Smith (Editor): Die Design Handbook, SME Publications.
3. P. Polukhin *et. al.*: Rolling Mill Practice, Mir Publishers.
4. K. Lange: Handbook of Metal Forming, McGraw Hill.
5. D.F. Eary and E.A. Reed: Techniques of Press working Sheet metal and Engineering Approach to Die Design, Prentice Hall.

MED 524(d) Quality Control and Industrial Inspection

	L	T	P
Credit	3	0	0
Hours	3	0	0

Quality Control: Quality improvement, need of Control, process capability analysis, quality capability study. Statistical quality control; objective, applications, organization, cost aspects, theory of statistical tolerances.

Control Charts: General theory of control charts, group control charts, control charts with variable sub-group *size,* moving average and moving range charts, acceptance control charts cumulative sum control charts and difference control charts.

Sampling Plans: Acceptance sampling, single, multiple and sequential sampling plans, multi-level continuous sampling, acceptance sampling by variables, sampling plans using different criteria, comparison of various types of sampling plans.

Industrial Inspection: Need and function of inspection in industry, organization, inspection, procedures and equipment, automatic and continuous inspection, inspection of screw threads, gears and surface finish flatness.

Non-destructive Testing: Radiography, magnaflux and fluorescent penetrant inspection, eddy current and ultrasonic tests.

Texts/References

1. A.J. Duncan, Quality Control and Industrial Statistics. Richard D. Irwin Inc., USA.
2. A.V. Feigenbaum, Total Quality Control, MGH, USA.
3. S. Halpern, The Assurance Sciences, PHI, New Delhi.
4. D.C. Montgomery, Design and Analysis of Experiments, John Wiley and Sons, USA.

MED 525 (MAJOR ELECTIVE – II)

MED525(a) Facilities Planning and Plant Engineering

	L	T	P
Credit	3	0	0
Hours	3	0	0

Plant location: Factors affecting the plant location, theories of plant location, procedure for plant location. Planning for physical facilities. Definition, scope, importance, objectives, functions and activities. Facility design and productivity. Type of layout and their economy, Organisation layout department.

Methodology for development of optimum layout and design: information collection necessary for layout planning, factors including plant layout- man, material, machine and equipment, flow and building services, safety, storage, procedure and stages for development of layout.

Techniques for analysis of method flow: need for the analysis of flow and use of process chart, multiproduct charts. Assembly chart, flow diagram. Flow process chart, activity relationship diagram, Travel and load charts, etc.

O.R. approval to plant layout: Line balancing, need for line balancing. Heuristic approach for line balance, mathematical models for line balance. Computerised layout: criteria for computerised layout programme, advantages and limitations of the method.

Material handling analysis and equipment: Principals of material handling and advantage of good handling. Design of material handling system and integration with plant layout. Selection and replacement of material handling equipment. Analysis of handling problems, Study and application of various types of material handling equipment.

Texts/References

1. J.A. Tompkins and J.A. White, Facilities Planning, Wiley.
2. J.M. Apple, Plant Layout and Materials Handling, Wiley, 1977.
3. R.L. Francis and J.A. White, Facilities Layout and Location, PHI.
4. J.A. Moore, Plant Layout and Design, Mcmillan.
5. D.M. Smith, Industrial Location, An Economic Geographic Analysis, Wiley.
6. Mirchandani and Handler, Location on Network, Wiley.

MED525(b) Product Design & Development

	L	T	P
Credit	3	0	0
Hours	3	0	0

Introduction to Design Engineering: Morphology of design, need analysis, specification of a problem. Problem formulation and problem analysis, design process and design cycle, creative design and introduction to decision making. Analysis of the product, standardization, simplification. Basic design considerations.

Design for Production: Producibility requirements in the design of machine components. Design for forging, casting, machining ease and powder metallurgical parts.

Strength, stiffness and rigidity considerations in product design.

Design Optimisation: Search for alternative solution and optimization aspects in design, qualitative discussions of various optimisation techniques.

Human factors in engineering design: Aesthetic and ergonomic considerations. Design of controls and displays.

Value Engineering: Nature and measurement of value, maximum value, normal degree of value, importance of value, the value analysis job plan. Steps to problem solving and value analysis, value analysis tests, material and process selection in value engineering.

Economic Factors Influencing Design: Product value. Design for safety, reliability and environmental considerations. Economic analysis, profit and competitiveness, break-even analysis. Economics of a new product design.

Modern Approaches to Product Design: Concurrent Design, Quality Function Deployment (QFD).

Texts/References

1. Chitale and Gupta: Product Design and Manufacturing, Prentice Hall of India.
2. Ulrich, K.T., and Eppinger, S.D., Product Design and Development, McGraw Hill.

MED525(c) OPTIMIZATION METHODS IN ENGINEERING

	L	T	P
Credit	3	0	0
Hours	3	0	0

Need for optimisation and historical development. Classification and formulation of optimisation problems, classical optimisation methods, differential calculus, Lagrangian theory, Kuhn-Tucker condition. Unconstrained minimisation techniques, one-dimensional minimisation techniques Fibonnacci, Golden section and quadratic interpolation methods. Multi-dimensional minimisation, Univariate, Conjugate direction, gradient and variable metric methods. Constrained minimisation techniques, penalty function methods, feasible direction and gradient projection methods. Introduction to geometric programming, linear programming and simplex method. Examples and applications of the above methods in the recent engineering design literature.

Texts/References

1. S.S. Rao: Optimisation-Theory and Applications, Wiley Eastern Ltd.
2. R.L. Fox: Optimisation Methods for Engineering Design, Addison Wesley.
3. W.I. Zangwill: Non-Linear Programming, A Unified Approach, Prentice Hall.

MED525(d) Robotics

	L	T	P
Credit	3	0	0
Hours	3	0	0

Introduction: Construction of manipulators, Advantages and disadvantages of various kinematics structure. Applications, Actuators, Pneumatic, Hydraulic and electric. Characteristics and control. Non-servo Robots, Motion Planning. Feed back systems, Encoders, Servo controls, PTP and CP. Kinematics, Homogenous coordinates, Solutions of the inverse kinematics problems, Multiple solutions, Jacobian, Work envelopes. Trajectory planning.

Manipulator dynamics and forced control Sensors: Vision, Ranging, Lasers, Acoustics, Tactile. Development in sensor technology, sensory control. Programming language: VAL, RAIL, AML. Mobile robots, Walking devices, Robot reasoning.

Texts/References

1. K.S. Fu, R.C. Gonzalez, C.S.G. Lee: Robotics, McGraw Hill.
2. Y. Koren: Robotics for Engineers, McGraw Hill.
3. J.J. Craig: Robotics, Edison Wesley.

MED 531 MAJOR ELECTIVE – III

MED531(a) Design of Material Handling Equipment

	L	T	P
Credit	3	0	0
Hours	3	0	0

Objectives of material handling systems and the basic principles, classification and selection of material handling equipment. Characteristics and applications. Discussion of various material handling equipments functions and parameters effecting service. Packaging and storage of materials and their relations with material handling. Theory, construction and design of various component parts of mechanical handling devices, wire ropes, chains, hooks, shackles, grabs, ladles and lifting electromagnets, pulleys, sheaves, shears, sprockets and drums, winches, brakes and ratchet stops, gears and power transmission systems, runner wheels and rails, buffers and controls of travel mechanisms.

Kinematics and dynamic analysis of various types of cranes and elevators. Stability and structural analysis. Discussion of principles and application of conveyors and related equipment. Design of various types of conveyors and their elements. Fault finding and failure analysis of material handling systems. System design and economics.

Texts/References

1. N. Rudenko: Materials handling Equipments, Peace Publishers, Moscow.
2. Spivakowsky and V. Dyachke, Conveyors and Related Equipments, Peace Publishers, Moscow.
3. R. John Immer, Materials Handling McGraw Hill.
4. E. Ernst, Die Hebezeuge, Band I and II, Springer Verlag.

MED531(b) Machine Tool Design

	L	T	P
Credit	3	0	0
Hours	3	0	0

Introduction to metal cutting machine tools, kinematics of machine tools. Basic principles of machine tools design, estimation of drive power. Measurement of power.

Machine tool drives. Electrical, mechanical and fluid drives. Stepped and stepless arrangements and systems.

Design of mechanical drives. Design of main and feed gear boxes. Special drives viz. Norton, Meander, etc. Gear calculations, choice of spindle bearings, belts, etc. typical gear layout of machine tools.

Machine tool structures– beds, columns, tables and supports, stock feed mechanisms. Control of machine tools, protective and safety devices. Design of precision machine tools, mirco-feeding device, concepts of modularity of design and integration for SPMs.

Machine tool structure design, strength and rigidity of machine tool structures, selection of structure shapes and materials. Static compliance. Design of lathe bed, use of reinforcing stiffeners in lathe bed. Design of column of drilling machine. Force analysis and design of milling machine.

Design of machine tool spindles, selection of bearings, slideways and guideways. Hydrodynamic action in slides.

Concepts of aesthetic and ergonomics applied to machine tools. Acceptance tests and standardisation of machine tools. Latest trends in machine tool design, introduction of CAD techniques.

Texts/References

1. G.C. Sen and Amitabha Bhattacharya: Principles of Machine Tools, New Central Book Agency, Calcutta.
2. N.K. Mehta: Machine Tool Design and Numerical Control, Tata McGraw Hill Co. Ltd, New Delhi.
3. Chitale and Gupta: Product Design and Manufacturing, Prentice Hall of India.
4. N. Acherkan: Machine Tool Design (Vol. 3 & 4), PIR publishers, Moscow.
5. CMTI Machine Tool Design Handbook.
6. A. Koenigsburger: Design Principles of Metal Cutting Machine Tools, Pergamon Press.

MED531(c) Design for Fatigue and Fracture

	L	T	P
Credit	3	0	0
Hours	3	0	0

Introduction to fatigue and fracture of machine elements, necessity of design based on fatigue and fracture.

High cycle fatigue and low cycle fatigue, fatigue data representation, parameters influencing fatigue strength and life, fatigue phenomena, various stages of fatigue process, design based on static properties and dynamic properties of materials, fatigue design procedures, preventing fatigue failures.

Brittle fractures, modes of fracture, linear elastic fracture mechanics, determination of stress intensity factor, fracture toughness, testing, elastic plastic fracture mechanics, design for fracture. Fracture mechanics and fatigue crack propagation. Failure analysis, investigation methods.

Texts/References

1. L. Sors, Fatigue Design of Machine Components, Pergamon Press.
2. S.T. Rolfe and J.M. Barsom: Fracture and fatigue Control in Structures, Prentice Hall.
3. D. Broek: Elementary Engineering Fracture Mechanics, Noordhoff.
4. A.F. Madayag: Metal Fatigue - Design and Theory.

MED531(d) Materials Management

	L	T	P
Credit	3	0	0
Hours	3	0	0

Introduction: Scope of materials management, primary and secondary objectives, integrated materials management, relation with other functional areas of organization.

Organizing for materials management: Basis for forming organizations, conventional and modern approaches to organizing materials management.

Materials identification: Classification, codification, standardization, simplification and variety reduction, Value analysis.

Inventory control: Techniques– FSN, VED, ABC, Various inventory models. Inventory models with quantity discount– Deterministic & Probabilistic Models.

Management of stores: Location, types of stores, methods of storing, safety and security of materials, stores equipment; materials handling equipment, factors affecting materials handling. Stores issues and receipts, procedures, forms and policies in stores transactions, stores accounting, stores organization.

Management of surplus obsolete and scrap materials: Reasons for accumulation of surplus obsolete and scrap materials, methods of disposal, regulations and procedures.

Purchasing: Planning purchasing materials, Materials requirements planning, Make or buy decision; vendor-rating, selection and development; purchasing procedures and methods; legal aspects, insurance of materials, supply management, sources of supply, out sourcing.

Sub contracting: Reasons for subcontracting, criteria for selecting sub contractors– rating, factors affecting subcontract rate fixing, internal and external subcontract.

Texts/References

1. Ballot, Materials Management, Taraporewala, Mumbai.
2. Ammer D.S., Materials Management, Taraporewala, Mumbai.
3. Gopalakrishnan P., Handbook of Materials Management, Prentice Hall of India.
4. Baily P. and Farmer D., Materials Management, Handbook, Gower Publications.

ME612 Internal Combustion Engines

	L	T	P
Credit	3	0	0
Hours	3	0	0

Thermodynamics of actual working fluid. Fuel air cycle. The actual cycle.

Air capacity of Four-stroke engines, Two-stroke engines Heat losses. Performance of un-supercharged and super-charged engines. Altitude behaviour of the un-supercharged engines.

Normal combustion, detonation and Pre-ignition in S.I. Engines. Combustion in Diesel Engines. Combustion in Petrol Engines.

Mixture Requirements, Carburettor Design of S.I. Engines, Fuel injection.

Wankel Engine, Stratified Charge Engines. Dual and Multiple fuel Engines.

Texts/References

1. P.W.Gill, J.H. Smith Jr. and E.J. Ziurys: Fundamentals of Internal Combustion Engines, Oxford and IBH Publishing Co.
2. L.C. Lichty: Internal Combustion Engines, MGH.
3. E.F. Obert: Internal Combustion Engines Analysis and Practice, International Textbook Co.
4. S.J. Young and R.W.J. Pryer: The testing of Internal Combustion Engines, DV Nostrand Co.

ME613 Value Engineering

	L	T	P
Credit	3	0	0
Hours	3	0	0

Value: Meaning and analysis of function, Meaning of use, esteem and exchange values.

Anatomy of functions: Basic vs. Secondary vs. Unnecessary functions, Evaluating functions.

Role of Management in value engineering: Responsibilities, Organization for VE, Orientation of management, budget auditing, Merit recognition.

Value engineering techniques: Scheduling of value engineering activity, Training for value engineering, Value management and Life Cycle costing.

ME614 Direct Energy Conversion

	L	T	P
Credit	3	0	0
Hours	3	0	0

Background of Direct Energy Conversion: Primary Energy Sources, Limitation on Energy Utilization, Principles of Energy conversion.

Irreversible Thermodynamics: Unified Theory of energy Conversion.

Thermoelectric Generation: Thermoelectric effect, The analysis of Thermoelectric Generator, Analysis of Thermoelectric Cooler; Figure of merit, Device configuration, Magneto-thermo-electricity.

Thermionic Generation: Radiation Principles.

Thermionic Generation: Thermodynamic Analysis of Thermionic Consert. The closed space High Vacuum thermoinic converter. The Low Pressure Diode. The High Pressure Cesium Converter.

Photovoltaic Generator: Radiation Principles. The p-n junction as a converter, the properties desired in Semiconductor for cell use. The design of a converter, Fabrication of cell, Reliability of solar Cells.

Magneto-Hydrodynamic Power Generators: Gaseous Conductor, Analysis of a M.H.D. Generator, Problem Associated with M.H.D. Power Generators.

Fuel Cells: Thermodynamic Principles. The efficiency of a Fuel Cell, Types of Fuel Cells, Design Considerations.

ME622 Applied Refrigeration

	L	T	P
Credit	3	0	0
Hours	3	0	0

Perishable Foods and the need for processing: Perishable foods. Pre-cooling Techniques and equipment. Time temperature histories and cooling loads.

Freezing: Techniques and equipment, Calculation of freezing rates.

Storage: Storage requirements for foods, Design and operation of cold stores, cold storage insulations, controlled atmosphere stores.

Dehydration: Convective drying and freeze drying, Heat and mass transfer during drying. Techniques and Equipments Transportation: Methods of refrigeration for land rail, sea and air transport of foods.

Design of Ice Plants, water coolers and milk storage plants Heat Pumps: Types and their design.

Application of Refrigeration: Manufacture and cold treatment photographic, libraries and museums.

Air conditioning: Fisheries, breweries, engineering, etc.

Texts/References

1. R.J. Dossat: Principles of Refrigeration, Pearson Education Asia.
2. J.L. Threlkeld: Thermal Environmental Engineering, Prentice Hall.
3. ASHRAE Fundamentals, 1989.

ME623 Combustion Engineering

	L	T	P
Credit	3	0	0
Hours	3	0	0

Thermodynamics of Combustion: Internal energy of reaction, enthalpy of combustion, enthalpy of formation. Bond energies. Adiabatic flame temperature. Equilibrium composition of gaseous mixtures.

Chemical Kinetics: Reaction order. Complex reactions, Reaction kinetics. Kinetics of chemical chain reactions, Reaction of hydrogen with oxygen, CO and CO_2.

Fuels and Combustion: Solid, liquid and gaseous fuels, their combustion.

Laminar Flame Propagation: Theories. premixed flames, structure of Laminar flame. Determination of burning velocities.

Turbulent Flame Propagation: Theories, Structure of turbulent flame; factors effecting turbulent burning velocity.

Diffusion Flames: Theories, gaseous diffusion flames, theory of turbulent diffusion flames, Jet flames.

Detonation Waves in Gases: Shock wave, detonation wave, calculation of detonation velocity.

Ignition: Self ignition, ignition delay, forced ignition factors affecting ignition energy.

Combustion Generated Pollution: Sources, nature of pollutants, their effect on man. Vegetation and materials. Vehicular emission, emission from power plants. Control measures. Measurement techniques. Air Pollution legislation.

Texts/References

1. N.A. Chigier: Energy, Combustion and Environment, MGH.
2. I. Glassman: Combustion, Academic Press.
3. A. Murthy Kanury: Introduction to Combustion Phenomena, Gordon and Breach, NY.
4. S.P. Sharma and Chandra Mohan: Fuels and Combustion, TMGH.

MINOR/SUPPORTING COURSES

MED 517 Computational Methods and Programming

	L	T	P
Credit	2	0	1
Hours	2	0	2

Roots of Nonlinear (Algebraic and Transcendental) Equations: Bisection method, False-position method, Newton-Raphson method, Newton's second order method, Secant method, roots of polynomials by Bairstow's method.

Solution of Simultaneous Linear Equations: Gaussian elimination, pivoting, Gauss-Jordan method, Gauss-Seidal method, Cholesky's method. Tridiagonal systems. Ill-conditioning. Evaluation of determinant. Matrix inversion, matrix inversion in-place.

Eigenvalues and Eigenvectors: Matrix iteration methods, power and inverse power method, Jacobi method.

Interpolation: Lagrangian and Hermite interpolation, cubic spline interpolation, Curve fitting, polynomial method, methods of least squares.

Numerical Integration and Differentiation: Numerical integration by trapezoid rule, Simpson's rule, Gauss quadrature. Romberg integration. Improper integrals. Numerical differentiation.

Solution of Differential Equations: Euler’s method, modified Euler's method, Runge-Kutta methods, predictor-corrector methods. Finite difference methods. Numerical solution of elliptical, parabolic and hyperbolic equations.

Practicals

Introduction to C/C++ programming language and software packages like MATLAB. Programming exercises on numerical solutions of problems taken from various fields of mechanical engineering.

Texts/References

1. S.S. Sastry: Introductory Methods of Numerical Analysis, PHI.
2. M.L. James, G.M. Smith and J.C. Wolford: Applied Numerical Methods for Digital Computers, Harper & Row Publishers, New York.
3. V. Rajaraman: Computer Oriented Methods, PHI.
4. Balagurusamy: Programming in ANSI C, TMH.
5. Brian W. Kernighan and Dennis M. Ritchie: The C-Programming Language, PHI.

MED 518 Total Quality Management

	L	T	P
Credit	3	0	0
Hours	3	0	0

Concept and philosophy of Total Quality Management. Understanding Quality. Quality Maintenance and Quality assurance, Quality Management Systems ISO 9000, Quality Planning Strategy; Quality audit documentation and information systems, Quality of work life, Quality circles, Organising and managing employee involvement, Union involvement and managers at various management levels, Statistical and Quantitative Techniques for total Quality control and assurance of products and process, Quality function deployment, Taguchi methods for offline control, The need for lifestyle approach to design and evaluation, Careful need for integration of Quality of maintenance, Reliability and productivity, Integrated Technology, People, Quality and productivity for achieving higher Quality of life.

Texts/References

1. Dale H.Besterfiled, et al., Total Quality Management, Pearson Education, Inc. 2003. (Indian reprint 2004). ISBN 81-297-0260-6.
2. James R.Evans & William M.Lidsay, The Management and Control of Quality, (5th Edition), South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).
3. Feigenbaum A.V. Total Quality Management, McGraw Hill, 1991.
4. Oakland J.S. Total Quality Management Butterworth - Hcinemann Ltd., Oxford. 1989.
5. Narayana V. and Sreenivasan, N.S. Quality Management - Concepts and Tasks, New Age International 1996.
6. Zeiri, Total Quality Management for Engineers Wood Head Publishers, 1991.

MED 526 Computer Aided Modelling and Analysis

	L	T	P
Credit	2	0	1
Hours	2	0	2

Use of popular Modelling and analysis packages (for example Solidworks, ANSYS, CATIA, etc.) for engineering modelling and analysis related to mechanical engineering. The students will be required to undertake a couple of minor projects in modelling, analysis and design using computers.

Texts/References

Reference Manuals of the relevant software.

MED 527 Reliability and Maintenance Engineering

	L	T	P
Credit	3	0	0
Hours	3	0	0

Reliability: Meaning, scope and objectives, reliability function and overall reliability, Availability and system effectiveness. Statistical concepts for reliability, Probability distributions and their use – Normal, Log normal, Poissons, exponential, Weibull, gamma & binomial.

Reliability of Systems: Models of reliability– series, parallel, redundant & Markov model.

Failure: Classification, causes, factors influencing failures, Failure data analysis, Failure analysis for design, General principles of design for reliability.

Risk Assessment: Definition and measurement of risk, risk analysis techniques, risk reduction resources, industrial safety and risk assessment.

Reliability Improvement and Simulation: Design and use of simulation models in reliability, Reliability audits.

Reliability Assessment and Testing: Reliability prediction, Reliability of mechanical and electrical systems. Reliability testing– requirement, methods and standards.

Maintenance: Maintenance information system– objectives and design, implementation, Use of computers in maintenance, Objectives and levels of maintenance.

Maintenance practices: Unplanned & planned, Preventive & scheduled, condition based & reliability centered maintenance, Total Productive Maintenance, Maintenance planning and scheduling, Maintainability.

Organisation for Maintenance: Objectives and functions, types of structures, Manpower planning, Materials for maintenance, planning and control.

Economic aspects of Maintenance: Life cycle costing, costs associated with maintenance and optimisation, Safety and Environmental aspects of maintenance.

Texts/References

1. R.C. Mishra: Reliability and Maintenance Engineering, New Age International Pub., New Delhi.
2. L.S. Buffa: Modern Production/Operations Management, Wiley Eastern, New Delhi.
3. L.S. Shrinath: Mechanical Reliability, Affiliated East-West Press P. Ltd.
4. Modarres: Reliability and Risk analysis, Mara Dekker Inc., 1993.
5. John Davidson: The Reliability of Mechanical system, Institution of Mechanical Engineers, London, 1988.
6. Smith C.O.: Introduction to Reliability in Design, McGraw Hill, London, 1976.

MED 532 MINOR ELECTIVE

MED532(a) Concurrent Engineering

	L	T	P
Credit	3	0	0
Hours	3	0	0

Introduction: Extensive definition of CE, CE design methodologies, Organizing for CE, CE tool box collaborative product development

Use of information technology: IT support, Solid modeling, Product data management, Collaborative product commerce, Artificial Intelligence, Expert systems, Software hardware co-design.

Design stage: Life-cycle design of products, Opportunity for manufacturing enterprises, Modality of Concurrent Engineering Design, Automated analysis idealization control, Concurrent engineering in optimal structural design, Real time constraints.

Manufacturing concepts and analysis: Manufacturing competitiveness, Checking the design process, Conceptual design mechanism, Qualitative physical approach, An intelligent design for manufacturing system, JIT system, low inventory, modular, Modelling and reasoning for computer based assembly planning, Design of Automated manufacturing.

Project management: Life Cycle semi realization, Design for economics, Evaluation of design for manufacturing cost, Concurrent mechanical design, Decomposition in concurrent design, Negotiation in concurrent engineering design studies, Product realization taxonomy, Plan for Project Management on new product development, Bottleneck technology development.

Texts/References

1. Anderson M.M. and Hein, L. Berlin, Integrated Product Development, Springer Verlog, 1987.
2. Cleetus, J. Design for Concurrent Engineering, Concurrent Engg. Research Centre, Morgantown, W.V., 1992.
3. Andrew Kusaik, Concurrent Engineering: Automation Tools and Technology, Wiley, John and Sons Inc., 1992.
4. Prasad, Concurrent Engineering Fundamentals: Integrated Product Development, Prentice Hall, 1996.
5. Sammy G. Sinha, Successful Implementation of Concurrent Product and Process, Wiley, John and Sons Inc., 1998.

MED532(b) Design of Heat Transfer Equipment

	L	T	P
Credit	3	0	0
Hours	3	0	0

Review of Fundamentals: Overall coefficient of heat transfer; controlling film coefficient, log-mean temperature difference (LMTD) for counter flow and parallel flow heat exchangers, caloric or average fluid temperature, wall temperature and various types of heat exchangers. Introduction to heat exchanger optimization.

Design of Double-pipe Heat Exchangers: Introduction, Film coefficients for fluids in pipes and tubes, Film coefficients and equivalent diameter for flow in annuli, Fouling factors, Pressure drop in pipes and annuli, Double-pipe exchangers in series-parallel arrangements.

Design of Shell and Tube Heat Exchangers: 1-2 Parallel- Counter flow shell and Tube Heat Exchangers: Constructional features of various types, Layout of tubes, various types of baffles and expansion joints, Shell-side film coefficients, shell-side mass velocity and shell equivalent diameter, True temperature difference in a 1-2 exchanger, Shell and tube side pressure drops, Analysis of performance, Exchangers without baffles.

Flow arrangements for increased Heat Recovery: 2-4 Exchangers and their comparison with 1-2 exchangers, 1-2 exchangers in series, 1-1 true counter flow exchangers, Design Calculations.

Design of Heat Exchangers with Extended Surfaces: Introduction and classification, Fin efficiency. Longitudinal fins and double pipe exchangers, Extended-surface shell and tube exchangers, cross-flow LMTD, film coefficients and pressure drop for transverse fins.

Design of Condensors: Dropwise and filmwise condensation, Condensing heat transfer coefficients, Horizontal and vertical tube condensors, Brief introduction to desuperheater condensors and condensor-subcoolers.

Texts/References

1. E.R.G. Eckerest and R.M. Drake Jr.: Analysis of Heat Transfer, MGH.
2. S. Kokac: Heat Exchangers- Thermal Hydraulic Fundamentals and Design Hemisphere, MGH.
3. D.Q. Kern and A.D. Kraus: Extended Surface Heat Transfer, MGH.
4. W.M. Kays and A.C. London: Compact Heat Exchangers, MGH.

MED532(c) Materials Technology

	L	T	P
Credit	3	0	0
Hours	3	0	0

Structure of Metals: Inter-atomic bounds, crystalline and amorphous solids, crystal imperfections.

Deformation of Metals: Elastics behaviour, Plastics deformation. Theory of dislocation, Strain hardening, Fracture of metals, ductile and brittle fracture.

Creep And Elevated Temperature Behaviour: Mechanism of creep, Analysis of creep curves, Prediction of creep behaviour, Creep tests, Effect of properties of elevated temperature, oxidation and scaling.

Fatigue: Mechanism of Fatigue Statistical nature *o*f fatigue, Factors affecting fatigue, Fatigue testing, Thermal stresses, Thermal shocks and Thermal fatigue.

Corrosion and Radiation: Mechanism of corrosion, Mechanical effects of corrosion, Protection against corrosion, Types of radiation, Effect of radiation on the mechanical behaviour of materials, Selection of materials.

Texts/References

1. S.L. Kakani and A. Kakani: Material Science, New Age International.

MED532(d) Non Traditional Machining Processes

	L	T	P
Credit	3	0	0
Hours	3	0	0

Non Traditional processes: Classification, Areas of application.

Electric Discharge Machining: Principle, Process parameters, EDM machines and controls, Wirecut EDM, Process optimization and control, Tool design for EDM.

Abrasive and Water jet machining: Mechanism of material removal, Process parameters, Process capabilities.

High energy beam processes like Laser beam machining, Electron beam machining, Plasma arc machining.

Chemical and allied processes like Chemical machining, Electro chemical machining Principle of Ultrasonic machining, capabilities and application.

Text/References

1. H.M.T., Production Technology, Tata McGraw Hill, New Delhi, 1980.
2. Pandey, P.C. and Shan, Modern Machining Processes, Tata-McGraw Hill Publ. Co. Ltd., New Delhi, 1980.
3. McGeough, J.A., Advanced Methods of Machining Chapman and Hall, London, 1988.

MED532(e) Maintenance Management

	L	T	P
Credit	3	0	0
Hours	3	0	0

Introduction: General objectives, Functions, Organization and administration of maintenance systems, Requirements, Concepts and structure of suitable organizations for maintenance systems.

Failure Analysis: Analysis for source identification, Classification land selectivity of failure; Statistical and reliability concepts and models for failure analysis.

Classification of Maintenance Systems: Basis and models for various maintenance systems.

Decision Models For Maintenance Planning: Operation and Control, Optimum level of maintenance, Replacement aspects of break down and preventive types, Group and individual types, Obsolete facility, Deteriorating and completely failing facilities, Replacement vs. reconditioning, Economics of overhaul, Addition replacement models-additive damage case, Zero memory case, Partially observed situation, Planning horizon procedure, Spare planning and control, Static spares, Insurance spares with and without salvage value.

Low moving spares: Manpower planning crew size, Allocation etc. stand-by machines, Economical and operational aspects, Scheduling planning of activities, Monitoring and updating, Resource allocation, Assigning priorities.

Cost Management for Maintenance: Cost estimates- Recording, Summarizing and Distributing cost data, Maintenance budget.

Other Relevant Topics: Work measurement for maintenance, Maintenance control indices, Maintenance service contracts, Preventive maintenance management-guidelines. Procedures, General management of lubrication systems, Organizing preventive maintenance.

Program using vibration signature analysis, some basic ideas, Management of records for maintenance, Computerization of maintenance activities, Major plant shut-down procedures.

Texts/References

1. Higgins L.T., Morrow L.C., Maintenance Engineering Hand-Book, McGraw Hill.
2. Newborought B.T., Effective Maintenance Management, McGraw Hill.
3. Lewis G.T. and W.W. Pearson, Maintenance Management, J.E. Rider.
4. Kelly A. & Harris M.J, Management of Industrial Maintenance, Newness - Butterworths, London.
5. Jarding A.K., Operations Research in Maintenance, Manchestor University Press.
6. Foster J.W., Phillips D.T. and Rogers T.R., Reliability, Availability and Maintainability, MIA Press.
7. Heintzelman J.E., The Complete Handbook of Maintenance Management, Prentice Hall.

ME615 Value Engineering and Productivity

	L	T	P
Credit	3	0	0
Hours	3	0	0

Concepts of Value and Utility: Philosophy of value Analysis and Value Engineering.

Techniques of Value Analysis: V.A. Job Plan, Determination of functions and functional evaluation, FAST diagram.

Application of Value Analysis: To make or buy, Elements of cost and cost classification. Maintainability and Availability.

Productivity: Concepts and measurements.

Productivity Analysis and Controls: Personnel-inventory and equipment.

ME616 Air-Conditioning

	L	T	P
Credit	3	0	0
Hours	3	0	0

Introduction: Industrial and comfort air-conditioning human requirements, physiological principles, effective temp, applications psychrometry, air-conditioning processes and combinations supply air state and rate.

Cooling and Dehumidification: Cooling dry and wet coils, chilled water spray, air washers and evaporative cooling, by-pass factor, chemical dehumidification.

Heating and Humidification: Heating by coils and heated spray humidification air, system analysis of heating and cooling processes.

Year Round controller, Psychrometry of automatic control of room conditions, dehumidification preheating and year round control.

Load Calculations: Solar radiation on building, solar angle and calculation of solar incidence, heat gain calculation of air-conditioning.

Ventilations: General principles of natural and mechanical ventilation, air cleaning and the equipment used.

Effects of Thermal Environment: Thermal exchanges of body with environment, body regulating processes, comfort air-conditioning, Industrial thermal environment.

Design: Detailed design of air-conditioning systems, involving equipment selection for year round control of conditions, designs of air distribution systems, plant room layout, fan and pumps.

Texts/References

1. ASHRAE Handbook: Fundamentals.
2. ASHRAE Handbook: HVAC Systems and Equipments.
3. J.L. Threlkeld: Thermal Environmental Engineering, Prentice Hall.

ME624 Refrigeration Engineering

	L	T	P
Credit	3	0	0
Hours	3	0	0

Vapour-Compression Refrigeration Systems: Review of vapour and air refrigeration systems. Theoretical and actual Cycles. Multi-stage systems and various combination, Cascade refrigeration systems. Properties of refrigerants and secondary refrigerants.

Vapour Absorption Systems: Developments, Theory of Mixtures and some processes. Use of charts. Principal of operating line, Ammonia-Water systems. Lithium Bromide-water systems. Three fluid absorption systems.

Other Refrigeration Systems: Water refrigeration, centrifugal refrigeration, steam jet refrigeration. Vortex tube and Pulse tube refrigeration systems, Thermoelectric systems, Production of dry Ice (solid carbon di-oxide).

Cryogenics: Minimum work required to liquefy a gas, cooling by expansion. Linde and Claude air liquefaction cycles and their analysis. Separation of air, liquefaction of hydrogen and helium.

Refrigeration Equipment: Evaporators, compressors, condensers Expansion devices, Ducts, etc. Design of above equipments. Balancing of components of refrigeration systems, control and production devices.

Texts/References

1. Dossat: Principles of Refrigeration, Pearson Education.
2. R. Barron: Cryogenic Systems, MGH.

COURSES OFFERED FOR OTHER DEPARTMENTS

ME618 CAD/CAM

	L	T	P
Credit	2	0	1
Hours	2	0	2

Computer Aided Design: CAD system components. Computer hardware for CAD. Display, input and output devices. Applications of computers to design modelling, engineering analysis and simulations. Introduction to FEM and its applications in CAD.

Design Optimisation: Search for alternative solution and optimization aspects in design, qualitative discussions of various optimisation techniques.

Computerised optimum design of simple machine elements i.e. shafts, springs, gears and gear trains etc. (flow charts only).

Computer Graphics: Role of computer graphics in CAD/CAM. Introduction to product data standards and data structures. Database integration for CAD/CAM.

Introductory concepts of display file, frame buffer, display control, display processors. Graphics primitives, points, lines and other primitives. Homogeneous coordinates. Transformations. B-spline and Beizer curves. Geometric modelling techniques, wire frames and introduction to solid modelling.

Computer Aided Manufacturing: Introduction to CAM, Components of NC system, NC coordinates and motion control systems. Computer numerical control, direct numerical control, combined CNC/DNC, economics of NC system. Punched tape, tape coding and format, manual and computer assisted part-programming, APT language.

Practicals

Preparation of drawings and modelling of engineering parts using popular CAD packages like AutoCAD, etc. Analysis of simple machine parts using software like ANSYS, CATIA, etc.

Development of simple computer programme for computer aided design of simple machine parts. Elementary exercises in part programming.

Texts/References

1. M.P. Groover and E.W. Zimmers: CAD/CAM - Computer Aided Design and Manufacturing, Prentice-Hall of India, New Delhi.
2. Surendra Kumar and A.K. Jha: Technology of Computer Aided Design and Manufacturing CAD/CAM, Dhapat Rai & Sons, Delhi.
3. T.R. Chandrupatla and A.D. Belegundu: Introduction to Finite Elements in Engineering, Prentice Hall of India, New Delhi.
4. T. Ramamurty: Computer Aided Mechanical Design and Analysis. Tata McGraw Hill, New Delhi.
5. I.D. Faux and M.J. Pratt: Computational Geometry for Design and Manufacture, John Wiley & Sons, NY.
6. Steven Harrington: Computer Graphics - A Programming Approach, McGraw Hill.
7. Donald Hearn and M. Pauline Baker: Computer Graphics, Prentice-Hall Of India, New Delhi.

Note:

1. For supporting courses course description, which are offered by other departments, refer separately syllabus of that particular department.
2. For syllabus of Non-Credit Compulsory Courses, see at the end.

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DEPARTMENT OF MINING ENGINEERING

VISION

- To keep its educational standards same as with the internationally well-known Mining Engineering Departments.
- To educate students to play an active role in industry, satisfying present and future needs of a global society through the development and implementation of revolutionary technologies for the extraction of mineral resources, and construction of underground structures in a socially responsible, economically viable, and environmentally sound manner.

MISSION

- To produce skilful and high quality engineers supported by up-to-date curriculum and scientific and industrial research to suit the industry both within the country and abroad
- To educate mining engineers who can follow and utilize the technological developments that may occur during their careers as well as lifelong learning and recognize the needs of an environmentally sensitive society for scientific and eco-friendly mining.
- To support the industry to enhance the techniques for their mining by providing databank, testing facilities, suitable consultancy and training services.

Programme Educational Objectives

1. To provide students with a sound foundation in Mine Planning and research work & their field applications.
2. A post graduate must have the background and necessary perspective to pursue doctoral/post doctoral education. A post graduate must be able to work with professionals in related fields over the spectrum of Mining engineering especially Mine Planning & designing, executing and monitoring of various mining systems.

3. To develop the analytical and logical aptitude amongst students to quickly adapt to new work environments, assimilate new information and problem solving.
4. To provide exposure of new cutting edge technologies to the students and to motivate them to take up new challenges to solve the problems faced by society and nation through research and development.
5. To inculcate self learning, discipline and leadership qualities with good communication skills in students and to introduce them to holistic approach of working in a team according to the codes of professional practice.

Programme Outcome

1. Postgraduates will demonstrate an ability to apply knowledge of advanced mining engineering, mathematics and relevant subjects applied to the field of mining engineering and planning.
2. Postgraduates will demonstrate in depth knowledge of topics which are critical to surface and underground mining especially mine planning.
3. Postgraduates will demonstrate the ability to function as a member of engineering and sciencel aboratory teams, as well as on multidisciplinary design teams.
4. Postgraduates will demonstrate the ability to learn and work independently to identify and solve mining related problems.
5. Postgraduates will demonstrate an understanding of professional and ethical responsibilities.
6. Postgraduates will posses effective communication skills both orally and in writing.
7. Postgraduates will have the confidence and potential to apply engineering solutions in global and social contexts.
8. Postgraduates will be disciplined and will show the capabilities of independent problem solving, self learning and innovation.
9. Postgraduates will be truly educated and will have a point of view regarding global scenario of the impact of mining technology on society andespecially on environment will demonstrate awa reness of contemporary issues at large.

Semester-wise Scheme for Post Graduate Programme in Mining Engineering

Details of courses offered for the award of M.Tech. (Mine Planning)

S. No.	Title	Course No.	Cr. Hr.	Semester			
				I	II	III	IV
Core Courses: Total 12 credits; 2 courses in first semester (6 credits) and 1 course each in second and third semester (3 credits each) to be evaluated externally.							
1	Operation Research	MIP 511	3 (3+0)	3	-	-	-
2	Rock Mechanics	MIP 512	3 (2+1)	3	-	-	-
3	Surface Mine Planning	MIP 521	3 (2+1)	-	3	-	-
4	Underground Mine Planning	MIP 531	3 (2+1)	-	-	3	-
Optional Courses: Total 15 credits; two courses in first & second semester each (6 credits in each semester) and one course in third semester (3 credits).							
1	Rock Excavation Engineering	MIP 513	3 (3+0)	3	-	-	-
2	Strata Control and Subsidence Engineering	MIP 514	3 (3+0)	3	-	-	-
3	Eco Friendly Mining	MIP 515	3 (3+0)	3	-	-	-
4	Project Management in Mines	MIP 522	3 (3+0)	-	3	-	-
5	Dimensional Stone Mine Planning	MIP 523	3 (2+1)	-	3	-	-
6	Stress Analysis Applied to Mining	MIP 524	3 (3+0)	-	3	-	-
7	Mine Economics and Business	MIP 532	3 (3+0)	-	-	3	-
8	Methods of Extraction	MIP 533	3 (3+0)	-	-	3	-
9	Geostatistics	MIP 534	3 (3+0)	-	-	3	-
10	Mine Ventilation Planning	MIP 535	3 (3+0)	-	-	3	-
Minor & Supporting Courses: Total 9 credits; one course in first, second and third semester each (3 credits in each semester).							
1	Mine Safety Engineering	MIP 516	3 (3+0)	3	-	-	-
2	Mine Environment and Ecology	MIP 517	3 (3+0)	3	-	-	-
3	Hydrogeology	MIP 525	3 (3+0)	-	3	-	-
4	Rock Slope Engineering	MIP 526	3 (3+0)	-	3	-	-
5	Mineral Exploration Engineering	MIP 536	3 (3+0)	-	-	3	-
6	Engineering Geology in Mine Planning	MIP 537	3 (3+0)	-	-	3	-
Others							
	Compulsory Courses; {(0+1) or (1+0)} Non Credit (NC); PGS Series	PGS501/502…	Non Credit	NC	NC	-	-
	Seminar (0+1)	MIP 538	1	-	-	1	-
	Comprehensive	MIP 539	NC	-	-	NC	-
	Research (Thesis). Thesis minimum duration 2 semesters	MIP 541	20	-	-	-	20
	Total Credit Hours (For Master Programme)		**57**	**15**	**12**	**10**	**20**

COURSE SUMMARY

Courses	No. of Courses					Credit Hours
	Semester					
	I	II	III	IV	Total	
Core	2	1	1	-	4	12
Optional	2	2	1	-	5	15
Minor & Supporting	1	1	1	-	3	9
Seminar	-	-	1	-	1	1
Comprehensive	-	-	-	1	1	Non Credit (graded as satisfactory/ non satisfactory)
Research (Thesis)	-	-	-	1	1	20* (graded as satisfactory/ non satisfactory)
Compulsory Courses (PGS Series)	1	1	-	-	2	Non Credit
Total	**6**	**5**	**4**	**2**	**17**	**57**

*Research (Thesis) credit load is not counted in calculation of final OGPA.

Details of Courses offered for the award of Ph.D. in Mining Engineering

S. No.	Title	Course No.	Cr. Hr.	Semester			
				I	II	III	IV-VI
Core Courses: Total 6 credits (3 credits in each semester) one course in first semester and one course in second semester to be evaluated externally.							
1	Applied Rock Mechanics	MIP 611	3 (3+0)	3	-	-	-
2	Safety & Risk Management in Mines	MIP 621	3 (3+0)	-	3	-	-
Optional Courses: Total 12 credits (6 credits in each semester) two courses in first and second semester each.							
1	Mine Environmental Planning	MIP 612	3 (3+0)	3	-	-	-
2	Surface Mine Planning	MIP 613	3 (3+0)	3	-	-	-
3	Underground Mine Planning	MIP 614	3 (3+0)	3	-	-	-
4	Applied Geology in Mining	MIP 615	3 (3+0)	3	-	-	-
5	Underground Space Technology	MIP 622	3 (3+0)	-	3	-	-
6	Rock Slope Engineering	MIP 623	3 (3+0)	-	3	-	-
7	Rock Fragmentation Engineering	MIP 624	3 (3+0)	-	3	-	-
8	Practices of Rock Mechanics Instrumentation	MIP 625	3 (3+0)	-	3	-	-
Minor & Supporting Courses: Total 9 credits, two courses in first semester (6 credits) and one course in second semesters (3 credits).							
1	Environmental Hazards and Disaster Management in Mines	MIP 616	3 (3+0)	3	-	-	-
2	Project Management	MIP 617	3 (3+0)	3	-	-	-
3	Engineering Geology	MIP 618	3 (3+0)	3	-	-	-
4	Drilling Technology	MIP 626	3 (3+0)	-	3	-	-
5	Waste Management in Mines	MIP 627	3 (3+0)	-	3	-	-
Others							
	Compulsory Courses+; {(0+1) or (1+0)} Non Credit (NC); PGS Series	PGS 501/ 502…	1	NC	NC	-	-
	Seminar	MIP 691/692	1 (0+1)	1	1	-	-
	Preliminary	MIP 632	NC			NC	-
	Research (Thesis). Thesis minimum duration 4 semesters	MIP 633	45	-	-	-	45
	Total Credit Hours Ph.D. (74)		**74**	**16**	**13**	**-**	**45**

Note: A Ph.D. student must take two 600 series core courses. A student may choose optional/minor & supporting courses of 500 series courses if not studied during Masters Programme as per ICAR guidelines.

\+ Exempted for those who have cleared these in Master's Programme (permission to be sought from the Dean, CTAE).

COURSE SUMMARY

Courses	No. of Courses Semester							Credit Hours
	I	II	III	IV	V	VI	Total	
Core	1	1	–	–	–	–	2	6
Optional	2	2	–	–	–	–	4	12
Minor & Supporting	2	1	–	–	–	–	3	9
Seminar	1	1	–	–	–	–	2	2
Preliminary	–	–	1	–	–	–	1	Non Credit (graded as satisfactory/ non satisfactory)
Research (Thesis)	–	–	–	–	–	1	1	45* (graded as satisfactory/ non satisfactory)
Compulsory Courses** (PGS Series)	1	1	–	–	–	–	2	Non Credit
Total	**7**	**6**	**1**	–	–	**1**	**15**	**74**

*Research (Thesis) credit load is not counted in calculation of final OGPA.
**Exempted for those who have cleared these in Master's Programme.

SYLLABUS

MINE PLANNING

CORE COURSES

MIP 511 Operation Research

	L	P
Credit	3	0
Hours	3	0

Course Outcome

In the present scenario, operation research plays important role. Details of the course enable the student to understand basic concept linear & dynamic programming, non linear programming, network analysis and statistic, to solve complex mining problems.

Syllabus

Introduction to Operation Research: Basic concepts.

Linear Programming: Simplex methods, dual problem and post optimality analysis.

Dynamic Programming: Concept, recursive equation approach, computational procedure, forward and backward computations and problems of dimensionality.

Network Analysis: Network representation, critical path calculations, probability and cost considerations in project scheduling, construction of time chart and resource leveling.

Inventory Models: Definition, deterministic and probabilistic models.

Non-linear Programming: Unconstrained external problems, constrained external problems, programming – separable, quadratic, stochastic and geometric.

Statistics: Correlation and regression; Principle of least square method and curve fitting.

Probability Distribution Functions: Random variable; Mathematical expectations; Moment generating functions; Discrete and continuous distribution functions; Binomial, Poisson and Normal distributions.

References

1. Taha Handy, *An Introduction to Operation Research*, Pub: Prentice Hall.
2. Morse Philip Mccord, *Methods of Operation Research*, Pub: Dover Publ.
3. *Memoria & Agarwal, Industrial Organisation, Pub: M/S Jain Brothers, Delhi.*
4 *Khana, O.P., A text book of Work Study. Pub: M/S Dhanpatrai & Sons, Delhi.*

MIP 512 Rock Mechanics

	L	P
Credit	2	1
Hours	2	2

Course Outcome

This professional course contents encourage the students to study and analyse various basic and advance aspects of designing underground structures by measurement of rock behaviour and rock mass. Also provide understanding of deformation and its measurement. Also provide model studies in geomechanics.

Syllabus

Rock mass and rock substances as a material, its properties and behavior, Rock mass classification and its applications in design, Water in rock. Site investigation and planning

Measurement, prediction and monitoring of rock behavior; In-situ stress measurements, Dynamic elastic behavior, Creep behavior, Heat flow and thermal behavior, Swelling of rocks, Behavior of discontinuities, Rock behavior monitoring and instruments- Planning, installation and operation of monitoring systems. Theories of rock failure, Stresses around mine excavation-estimation by analytical & experimental methods.

Practicals

1. Calculate RMR based on given deposit data..
2. In –situ stress measurement techniques.
3. Prediction and monitoring of rock behavior.
4. Estimation of stresses around mine excavation.
5. Monitoring of displacement in strata with multipoint borehole extensometers.
6. Mohr's rock failure criteria.
7. Designing of U/G structures based on rock mass classification.

References

1. *Obert & Duall, Rock Mechanics and design of structures in rock. Pub: John Willey & Sons.*
2. *Z.T. Bieniawski, Rock Mechanics Design in Mining and Tunneling, Pub: A.A. Balkema, P.O. Box 1675, 3000 BR Rotterdam, Netherlands.*
3. *Hoek E. and Brown, E.T. Underground excavations in Rock, Institutions of Mining and Metallurgy, London.*
4. *Brown, E.T., Rock characterization, testing and monitoring – ISRM suggested method, Pergamon Press, Oxford.*
5. *William A. Hustrulid (Editor), Slope Stability in Surface Mining*.
6. *Hoek and Bray, Rock slope Engineering, Taylor & Francis.*

MIP 521 Surface Mine Planning

	L	P
Credit	2	1
Hours	2	2

Course Outcome

At present 80% of the coal production and significant proportion of other mineral output is coming from surface mines and hence students get a benefit of basic and advanced understanding of various techniques of surface mining including operation and maintenance of associated

machinery as outcome of this course. Also the students will learn about the research and analysis in the field of advanced drilling and blasting operations in surface mining.

Syllabus

Pit slope. Cut off grade. Stripping ratio. Pit configuration. Annual production and life of the mine. Bench dimensions.

Opening of deposits and formation of benches. Width and slope of entry trenches. Systems of overburden removal and disposal:, Overcasting, Haulage and combinations. Layout designs for various deposit configurations. Waste dumps.

Operation of dragline on extended bench and vertical tandem.

Selection of drilling, excavation, transport and auxiliary equipment: type, specifications and number.

Selection of Explosives. Blast design for fragmentation. Design considerations for mitigating blasting nuisances.

Optimisation of shovel-dumper combination. Computerized dispatch systems. Haul road design. Applications of other HEMM. GPS control.

Power distribution. Communication.

Assessment of make of water. Design of drains, sumps and pumping systems. Water treatment.

Planning for reclamation. Controlling air pollution and equipment noise.

Measures for spontaneous heating, Fire prevention and fighting.

Application of software's in surface mine planning and surveying.

Practicals

1. Calculate annual production and life of the mine of a deposit.
2. Design of box cut and formation of benches.
3. Designing systems of overburden removal and its disposal.
4. Layout designs for various deposit configurations.
5. Haul road design in well mechanized opencast mines.
6. Optimization of shovel-dumper combination.
7. Open pit mine planning using Datamine/surpac software of a deposit.

References

1. William A. Hustrulid, Michael K.McCaarter &Dirk J. A. Van Zyl; "Slope Stability in Surface Mining" SME Publication 2001.
2. Ray Lowrie; "SME Mining Reference Handbook" SME Publication 2002.
3. Haward L Hartman; "Introductory Mining Engineering" A. A. Balkema Old post Road, Publisher Old Post Road, Post Roag Brook Field USA.
4. Das S. K.; "Surface Mining" Geeta Book Store", Dhanbad.
5. Das S. K.; "Morden Coal Mining" Geeta Book Store", Dhanbad.
6. Jayant Bhattattacharya; "Principle of Mine Planning" Allied Publisher' Pvt. Ltd., New Delhi.

MIP 531 Underground Mine Planning

	L	P
Credit	2	1
Hours	2	2

Course Outcome

Now a days there is a challenge in mining industries is to produce all the major quantity product through underground mining and hence details of planning such mines is highly solicited from the students aspiring to be a good mine manager, planner, researcher, academician, etc. Better understanding and developing analysis capabilities to the challenges in planning underground mining project is also an outcome of this course. Student can be able to plan extraction methods for metal mining by underground techniques. Also, underground coal mine planning is need of the hour and through this course student can get opportunity to be specialist in planning for such underground coal mining projects as outcome of this course.

Syllabus

Underground Metal & Coal Mining Industry in India - An overview.

Feasibility and project reports: Contents, preparation and evaluation. Preparation of mining plan & mine environmental plan.

Cut off grade. Reserves. Delineation of mining area. Annual output and life of the mine.

Opening of single and multiple veins at various inclinations. Type (shaft, incline or adit), number, location and design of mine entries.

Division of the mining area into working units on district and level pattern. Dimensions of panels and blocks.

Selection and optimisation of appropriate mining methods. Production planning and scheduling.

Application of numerical modeling & computers in mine planning and design.

Underground Mine Planning and Design - scope of mining activities, General stages of mine planning.

References

1. Ray Lowrie; “SME Mining Reference Handbook” SME Publication 2002.
2. William A. Hustrulid, Rechard Bullock; “Underground Mining Methods” SME Publication.
3. Haward L Hartman; “Introductry Mining Engineering” A. A. Balkema Old post Road, Publisher Old Post Road, Post Roag Brook Field USA.
4. Hustrulid; “Underground Mining Methods”.
5. Jayant Bhattattacharya; “Principle of Mine Planning” Allied Publisher’ Pvt. Ltd., New Delhi.

Practicals

1. Preparation of feasibility /project report.
2. Preparation of mining plan.
3. Preparation mine environmental plan.
4. Application of numerical modeling & computers in mine planning and design.
5. Production planning and scheduling with software based on given conditions.
6. General stages of mine planning.
7. Selection and optimization of appropriate mining methods based on given conditions.

OPTIONAL COURSES

MIP 513 Rock Excavation Engineering

	L	P
Credit	3	0
Hours	3	0

Course Outcome

Mining engineers specialized in various aspects of drilling and blasting and other excavation technologies including recent concepts of blastless mining with continuous miners/surface miner designs is expected as an outcome of the course. Basic & advanced knowledge and research and analysis capabilities in the field of explosive and blasting technology are also expected outcome of this course.

Syllabus

Present status of drilling and blasting practices in India and abroad, Mechanics of drilling, Drilling Methods, Characterization and different types of machines, Bits design and wear, bit types and bit selection, Rotary drilling applications, Optimizations of drilling variables, Water jet drilling, Thermal drilling, Drillability of rocks, splitting and cutting rocks.

Explosive and Blasting theory, Calculations for design of blasting systems in surface mining and underground operations. Control of blasting operations. Influence of rock properties and geology, Overcasting with explosive, Trench blasting, Specialized blasting.

Blasting for dimensional stone excavation, Controlled demolition of structures.

References

1. Bhandari S.; “Engineering Rock Blasting Operation” A. A. Balkema Publishaer Old Post Road, Brook Field, TO5036, USA.
2. Dr. Calvin Konya; “Rock Blasting and Overbreak Control” Precision Blasting Services, Montville, Ohio.
3. William H. Hansmire and I. Michael Gowring; “Rapid Excavation and Tunneling Conference 2001” SME Publication.
4. ISEE Blasters Handbook ISEE Publication Cleveland, Ohio.
5. G. A. Bollinger; “Blast Vibration Analysis” ISEE Publication Cleveland, Ohio.
6. C. H. Dowding; “Blast Vibration Monitoring and Control” ISEE Publication Cleveland, Ohio.
7. William Hustrulid; “Blasting Principles for Openpit Mining” ISEE Publication Cleveland, Ohio.
8. C. P. Chug; “High Technology in Drilling and Exploration” Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

MIP 514 Strata Control & Subsidence Engineering

	L	P
Credit	3	0
Hours	3	0

Course Outcome

This professional course contents encourage the students to study various aspects of strata control problems in underground mines with a better understandings of subsidence in the mine. Also provide understanding of design and analysis of roof support system and roof bolting.

Syllabus

Strata control: Estimate of support requirement based on rock characteristics & rock deformations; Rock mass classification - Terzaghi rock load classification, Rock structure rating, Rock mass rating, Q-system etc.; General considerations of support design for underground excavations, Mechanics of various support systems- Props, Power supports, Shield support, Arch supports, Concrete lining etc. Roof support design in hard rock (metal) mining and soft rock (coal) mining, Shaft pillar design, Design of shaft support systems, Mechanics of rock bolting.

Subsidence: Theories of subsidence, problems & preventive measures in Indian mines, Subsidence monitoring, Rehabilitation measures etc. Shaft pillar design.

References

1. Haward L Hartman; “Introductory Mining Engineering” A. A. BalkemaOld post Road, Publisher Old Post Road, Post Roag Brook Field USA.
2. R. D. Singh; “Principles & Practices of modern Coal Mining” New Age International Pvt. Ltd. New Delhi.
3. Vail, CO; “Rock Mechanics for Industry” Proceeding of the 37th Symposium on Rock Mechanics Vol. 1-2, ISEE Publication Cleveland, Ohio.
4. Cummins & Givens; “SME Mining Engineering Handbook, Vol. I & II” A.I.M.M.New-York.

MIP 515 Eco-Friendly Mining

	L	P
Credit	3	0
Hours	3	0

Course Outcome

Students can understand the environment friendly mining techniques. Details of the course enable the student to understand basic concept of environment friendly mining methods, equipment etc. Also students should have sound knowledge of pre mining geo-environmental studies and waste management.

Syllabus

Pre-Mining Geo-Environmental Studies: Geo-chemical investigation, weathering and migration processes, hydro-geological influences, soil development profile, eco-system.

Environmentally Oriented Mining Methods: Simultaneous mining and reclamation; controlled and auto mining techniques - contour mining, flooding of mine to prevent pyrite oxidation, rock breaking in environmentally sensitive area, control of runoff, reclaimed contour, strip mining, terrace mining, re-grading, re-vegetation, mine sealing.

Techniques to make solution mining, leaching and ocean mining environmentally safe.

Environment Friendly Mining Equipment : Acoustically designed, illumination designed and hydraulically operated machines - Drills, fans, cutting, loading and hauling machine. Arrangement for control of dust and toxic gases generation. Its suppression on machines during operation. Fire protection and control devices on machines.

Mineral Resource and Waste Management: Resource conservation and utilization. Waste management - mine waste rocks, mill tailings, washery rejects, gaseous, liquid and solid by-products, processing, utilization and disposal of mineral wastes, waste recycling.

References

1. Rekha Ghosh, D. S. Chatterjee; "Environmental Geology" Capital Publishing Co. New Delhi.
2. "Environmental Geology: Geo-ecosystem Protection in Mining Areas" Capital Publishing Company, New Delhi *Dr. B.B. Dhar, Environmental Management of Mining Operations. Pub.*

MIP 522 Project Management in Mines

	L	P
Credit	3	0
Hours	3	0

Course Outcome

At the end of the course, the student will understand the market dynamics namely, demand and supply, demand forecasting, elasticity of demand and supply, pricing methods and pricing in different market structures. Also, gain an insight into how production functions are carried out to achieve least cost combination of inputs and cost analysis. Students will be able to solve or optimize the system through understanding of network analysis, project monitoring and HRD management.

Syllabus

HRD management: Definition, function and objectives of human resource management, Role of human relations in HRM, qualities of good human resource manager, Evolution and growth of HRM in mineral industries, Future of HRM in mineral industry, Human resource philosophy and policies.

Project planning & control : project monitoring through network techniques – PERT & CPM, concepts of time estimates and project costs, Resource levelling.

Capital budgeting techniques: Basic concept of cash flow, component of cash flows, Investment evaluation criteria: Payback period, Accounting rate of return, net present Value, Internal rate of return, profitability Index Brief overview of risk analysis in capital budgeting.

Capital structure decisions: Capital structure, Features and determinants, cost of capital & its significance, component costs of capital: cost of debt, cost of equity capital cost of preference capital, cost of retained earnings, weighted average & marginal cast of capital.

Market and technical appraisal: Market and demand supply, Technical analysis, Financial and economic appraisal of mining project: costs and benefits, Appraisal criteria, Cost of capital, risk analysis of single project, multiple project and constraints.

References

1. Jayant Bhattattacharya; “Quality Control and Management: Methods and Practices in the mineral industry” Allied Publisher’ Pvt. Ltd., New Delhi.
2. Sukumar Bandopadhyay; “Application of the Computers and Operation Research in the Mineral Industry” Proceedings of the 30th international Symposium SME Publication 2002.
3. Banga & Sharma; “Engineering Economics and Industrial Organisation” Khana Publishers, New Delhi.
4. F.S. Hillier and G.J. Liebermann, Introduction to Operation Research, Holden Day.

MIP 523 Dimensional Stone Mine Planning

	L	P
Credit	2	1
Hours	2	2

Course Outcome

Dimensional Stone Technology is important to get idea of advanced planning to excavate blocks of marble, granite, sandstone etc. Students get a benefit of detailed understanding of various advanced techniques of dimensional stone mining including diamond wire saw, blind cut technique etc. Also have complete idea of waste generation and their proper management.

Syllabus

Dimensional stone industry in India and abroad. Recourses of various types of dimensional stones. Reserve estimation techniques. Removal of overburden, overburden disposal and reclamation of dump yard. Development of free faces under development, techno-economical evaluation of deposit.

Selection of suitable extraction techniques for various deposits, recent development of mining equipment and Heavy Earth Moving Machinery and mechanization.

Planning of various deposits by opencast and underground excavation techniques measures for improving recovery.

Blasting Techniques in dimensional stone mines, various types of explosive used, controlled blasting for providing horizontal and vertical cut.

In-situ filling of cracks.

Geo-technical consideration for extraction of stones.

Stability of strata in deeper mines.

Waste generation at quarry site and processing site & its management.

Practicals

1. Brief account of dimensional stone industries in India and abroad.
2. Techno-economical evaluation of a dimensional stone deposit.
3. Recent development of mining equipment used in extraction of dimensional stone deposit.
4. Geo-technical considerations for extraction of stones.
5. Controlled blasting techniques in dimensional stone mines.
6. Waste management and its minimization techniques of a mechanized mine.
7. Extraction of dimensional stones with underground techniques based on given data.

References

1. Rathore S. S., Bhardwaj G. S., Jain S. C*; "Dimensional Stone Technology" Himanshu Publication New Delhi.*
2. Rathore S. S., Laxminarayana V*.; "Safety and Technology in Marble Mining and Processing in New Millennium" Proc. Of National Workshop held march 10-11 200 Udaipur.*
3. Rathore S. S., Gupta Y. C., Parmar R. L.; "Recent Development in Machinery and Equipment for Dimensional Stone Mining" held Dec. 13-14, 2003 at Udaipur.
4. India Stones, Business Magazine on Indian Stone Industry, Pub. ICONZ Communications, 203, Mahaveer Residency, 15 Main J. P. Nagar, 5th Phase, Bangalore.

MIP 524 Stress Analysis Applied to Mining

	L	P
Credit	3	0
Hours	3	0

Course Outcome

This professional course contents encourage the students to study various aspects of fracture mechanism, stress & strain analysis techniques to solve the complex problems related to underground structure designing.

Syllabus

Elementary elasticity and fracture mechanism: stress; strain & stress relationship; two dimensional stress analysis.

Strain measurements method & instrumentation: strain measurement & its relation to experimental determination, properties; types of strain gauges - electrical resistance, mechanical, semi-conductor; strain gauges circuits; strain recording instruments; strain analysis method.

Non-destructive testing, Brittle coatings. Some application of experimental stress analysis and research, design and field problems.

References

1. Obert & Duall, Rock Mechanics and design of structures in rock. Pub: John Willey & Sons.
2. Railey & Dalley, Experimental stress analysis. Pub: McGraw Hill Book Company.
3. Vutukuri & lama, Handbook of Mechanical properties of rock Vol.I&II. Pub: Transtech, Germany.
4. Syd.S.Peng, Coal Mine Ground Control. Pub: John Willey & Sons.
5. J.C. Jeager & NGW Cook, Fundamentals of Rock Mechanics. Pub: Chapman & hall, London.
6. Charles Jaeger, Rock Mechanics & Engineering. Pub: Cambridge University Press, Cambridge London.
7. Manual on Rock Mechanics, Prepared by Central Soil & Materials Research Station, New Delhi, Add: Central Board of Irrigation and power Malcha Marg, Chanakyapuri, New-Delhi- 110021.

MIP 532 Mine Economics and Business

	L	P
Credit	3	0
Hours	3	0

Course Outcome

Any industry's development depends largely on profit besides other parameters and mining is no exception. Details of the course enable the student to understand various issues related to finance /accounts starting from project planning stage, presentation of account, balance sheet etc. And also to get idea of cost analysis, mineral asset valuation etc.

Syllabus

Introduction and Basic concepts of mineral economics; feasibility studies; taxation; metal pricing and marketing; mineral rents; royalties and compensation; concepts of exhaustibility and cut-off grade.

Application of time value of money concepts to development of decision criteria used to evaluate the economic potential of investments.

Advanced Mineral Asset Valuation- evaluation of project worth by various criteria such as present value, discounted cash flow, rate of return, breakeven point; sensitivity analysis. Advanced discounted cash flow techniques and the emerging use of option, pricing theory in the evaluation and management of mineral properties.

Monte Carlo techniques to deal with the uncertainty in capital budgeting particularly applicable to mineral investments. A systematic method of calculating the effects of political risk on mine value.

Mine costs: Basuca concept – capital and operating costs, techniques of estimating future costs. Volume-cost-profit analysis and decision making with the cost data.

International trade & investment practices for major minerals/products.

References

1. John C. Hull's book, Options, Futures and Other Derivative Securities, 5th edition (2002).
2. Avinash Dixit and Robert Pindyck, Investment under Uncertainty (1994).
3. E.G. Hellewell, "Financing and Financial Evaluation of Mining Projects," Mineral Deposit.
4. Ross R. Bhappu and Jaime Guzman, " Mineral Investment Decision Making".
5. Lenos Trigeoris, " A Real –Options Application in Natural-Resource Investment".
6. Frank J. Fabozzi (ed.) Advances in Futrures and Options Research, Vol (Greenwich: JAI Press, 1990).
7. Gentry, D.W. and O'Neil, T.J. (1984), Mine Investment Analysis, Pub: Society of Mining Engineers.
8. Batman A.M. "Economic mineral deposits".

MIP 533 Methods of Extraction

	L	P
Credit	3	0
Hours	3	0

Course Outcome

This course is enable the student to get idea of modern concept applied for extraction of coal and metal mining deposit. Slope design aspect is very important in designing opencast mining. Better understanding of the challenges in surface mining, underground metal and coal is also an outcome of this course.

Syllabus

Global roundup of surface Mining practices: Quarrying, Pitting, Stripping, Hydraulic Mining etc.

Slope design: for competent rock, loose rock, fractured rock, clayely rock in different ground water conditions. Ultimate pit Slope, Bench angle, berm width determination.

Ultimate pit layout over-casting by explosive and blast design, optimization of load-haul systems.

Modern Concepts in present underground Metal mining systems.

Special mining techniques and problems in soap stone underground extraction.

Modern Concepts in present underground Coal mining systems: Bord & pillar extraction, Longwall mining, Thick seam, Steep seam, Blasting gallery techniques etc.

Selection of underground method of extraction, with geo-mechanical and environmental considerations, case studies.

References

1. Ray Lowrie; “SME Mining Reference Handbook” SME Publication 2002.
2. Das S. K.; “Surface Mining” Geeta Book Store”, Dhanbad.
3. Robert Peele; “Mining engineers’ Handbook”.
4. Das S. K.; “Surface Mining” Geeta Book Store”, Dhanbad.
5. Haward L Hartman; “Introductory Mining Engineering” A. A. Balkema Old post Road, Publisher Old Post Road, Post Roag Brook Field USA.
6. R. D. Singh; “Principles & Practices of morden Coal Mining” New Age International Pvt. Ltd. New Delhi.
7. Das S. K.; “Morden Coal Mining” Geeta Book Store”, Dhanbad.
8. Hustrulid; “Underground Mining Methods”.

MIP 534 Geo-statistics

	L	P
Credit	3	0
Hours	3	0

Course Outcome

Students are expected to learn the basics of Geo-statistics, its use in mine planning and resource estimation. Also the planning and designing the underground and opencast mine through the geo-statistical based softwares will also be the outcome of this course.

Syllabus

Classical statistics: Normal and Random distributions; Spatial statistics: Covariogram, semi- variogram.

Introduction of Geo-statistical techniques, Statistical analysis of sample data, Rationalized variables, Structural analysis-variogram, Kriging-types, properties, kriging program, application of kriging, random and universal kriging, Estimation of insitu resources, Recoverable resources, Case studies.

Grade tonnage relationship, Error estimation techniques, Nugget effect, Geo-statistical modeling of ore body.

References

1. Sharma D. D.;"Geo-statistics with Application in Earth Sciences" Capital Publishing House New Delhi.
2. Isabel Clark; "Practical Geo-statistics" Applied Science Publisher London.
3. Mrgaret Armsstrong; "Basic Geo-statistics for the Mining Industry" Centre De Geostetistique Fountain ebleau, France.
4. Rendu J. M. "An Introduction to Geo-statistical Methods of Mineral Evaluation" Johannesburg.
5. Delfiner P.& Delhome J.P.; "Optimum interpolation by Krigging: Display and Analysis of special data" John Wiley and Sons, New York.
6. Journal A.G. & Hujberegts; Mining Geo-statistics, Academic Press, London.
7. Sabourian R,; Geo-statistics as a tool to define Various Categories of Resources.

MIP 535 Mine Ventilation Planning

	L	P
Credit	3	0
Hours	3	0

Course Outcome

Student can understand the ventilation requirements for underground mines including knowledge of basic and advanced designing, requirement of gases and restricting the noxious and inflammable gases. Also the effect of , heat, humidity on the human body and their remedial measures and role of these in the advanced mine ventilation planning can be an outcome of this course.

Syllabus

Advanced treatment of Air flow in Mines; Thermodynamics considerations; Instrumentation and monitoring in mine ventilation and air conditioning. Natural splitting problems by Hardy-Cross and other techniques. Environmental monitoring and automatic control systems.

Central and boundary ventilation. U, W and Z air routes. Ventilation schemes for various methods of working. Estimation of the operating pressure and air quantity requirements of mine. Selection of the main fan. Series and parallel operation of fans. Design of fan drift and evasee. Ventilation network analysis. Preparation of ventilation plans for underground mines. Control of heat and humidity through air quantity regulation and refrigeration. Control of dust, fumes and other pollutants.

MINOR & SUPPORTING COURSES

MIP 516 Mines Safety Engineering

	L	P
Credit	3	0
Hours	3	0

Course Outcome

Exposure to state and central laws related to safety in mining are highly solicited. This course gives an opportunity for the students to understand the statutory requirement for coal/metal mining by opencast/underground methods. Also Student will be able to work better as safety officials in mining projects with detailed knowledge in safety management, accident approaches.

Syllabus

Safety concepts: System safety definition, Risk concept, System safety information, Operating experience, Test analysis assumption, Safety standards.

Classification of failures accidents, Protective action classification, Accident consequence acceptance credibility limit, Safety design criteria and principles, Uncertainties in safety measurement, System safety analysis, Preliminary hazard analysis.

Failure mode and effect analysis and critical analysis, Subsystem fault hazard analysis, Common mode failure analysis, Cascade fault tree methodology, Cause-consequence approach, Block diagram method, Analytic method, Hazard simulation techniques.

Computer codes for safety analysis.

References

1. Kejriwal B.; “Mine Safety and Legislation” Dhanbad.
2. *Rakesh & Prasad, Legislation in Indian Mines Vol. I & II. Pub: Mrs. Asha Lata Varanasi.*
3. *Rathore S. S., Laxminarayana V.; “Safety and Technology in Marble Mining and Processing in New Millennium” Proc. Of National Workshop held March 10-11, 2000, Udaipur.*

MIP 517 Mine Environment and Ecology

	L	P
Credit	3	0
Hours	3	0

Course Outcome

In the present scenario, environmental management and eco-friendly mining has become integral part of mine planning. Details of the course enable the student to understand various issues related to environmental management of mines such as preparation of EIA and EMP, Mine closure planning, laws related to mine environment. The waste minimization and waste utilization understanding and its inclusion in the planning can be an outcome of this course.

Syllabus

Environmental Impacts associated with mineral mining and processing-Ecological pollution.

Future trends in mining. Major environmental concern associated with mining and its managements

Reclamation of opencast mine with special reference to degradation and reclamation, Role of geology in environmental studies.

Air Pollution in mining areas and its control. Dust Pollution, Acid mine water drainage and control, Noise pollution and control.

Environmental determinants for mining, settlements, design of living environmental of mining, settlements.

Pollution as a result of tailing disposal from mineral process/ coal process plants.

Utilization of mine waste and tailings.

Case histories-economics and control measures of pollution in general.

References

1. Rekha Ghosh, D. S. Chatterjee; "Environmental Geology" Capital Publishing Co. New Delhi.
2. "Environmental Geology: Geo-ecosystem Protection in Mining Areas" Capital Publishing Company, New Delhi.
3. *Dr. B.B. Dhar, Environmental Management of Mining Operations. Pub.*

MIP 525 Hydrogeology

	L	P
Credit	3	0
Hours	3	0

Course Outcome

Students are expected to learn the basics of Hydogeology and its effect in various operations of underground and opencast mines. Also the planning and designing the underground and opencast mine through the hydrogeology will also be the outcome of this course.

Syllabus

Scope of hydrogeology and geo-hydrology, Ground water utilization, Elements of hydrogeology, Hydrologic cycle, Quantitative study of the basins, Relationship of precipitation and runoff, Groundwater flow, Flow regime, Properties of the medium, Interrelationship between ground water and surface water, Ground water budget, Theories of ground water movement, Steady state flow, Mechanics of flow, Numerical and experimental methods in Ground water flow, Groundwater mapping techniques, Confined and unconfined flow, Geo-hydrologic parameters estimation techniques, Computation of transmissibility, Radiotracer techniques for determining ground water velocity and direction, Aquifer geometry and estimation of parameters, Instrumentation and technique of ground water exploration, Fracture pattern modeling for ground water, Acquisition of hydro-geological data, Role of computer in hydro-geological investigation.

References

1. Basant K.Mishra and Ramesh Shukla. Planning and Development of Groundwater Resources in India- A Perspective for the 21st Century. Satyam Publications Patna-800 006.
2. Hantush, M.S., Hydraulics of Wells, Advances in Hydroscience. Academic Press, Inc., New York.
3. Karanth, K.R. 1987, Groundwater Assessment, Development and Management, Tata McGraw Hill.
4. Guidebook on Nuclear Techniques in Hydrology, 1983, Technical Report Series No. 1, I.A.E.A., Vienna.
5. Shultz, G.A. and Engman, E.T. (2000). Remote Sensing in Hydrology and Water Management. Springer, New York.

MIP 526 Rock Slope Engineering

	L	P
Credit	3	0
Hours	3	0

Course Outcome

Students can understand the fundamentals of slope and its stability in opencast mining. The understanding of the subject & slope parameters and slope design capabilities are the outcome of this course.

Syllabus

Role of Slope Stability in Economic Design and Operation of Open Pit Mines, Types and Mechanics of Slope Failure.

Types of slope failure; falls, slides and flows. Mechanics of slope failure : plane failure, wedge failure, circular failure, toppling failure, bucking failure, Prandtl type failure, block failure and key block failure.

Factors Affecting Slope Stability: Geologic factors, slope geometry, ground water, equipment loading, dynamic loading, effect of time.

Slope Stability Analysis

Deterministic and probabilistic approaches. Methods of slope stability analysis. Safety factor. Physical, analytical and numerical models for rock and soil slopes.

Field instrumentation and monitoring. GPS essential monitoring. Stabilisation and strengthening of slopes.

Design of waste dumps and tailings dams.

References

1. William A. Hustrulid, Michael K.McCaarter &Dirk J. A. Van Zyl; “Slope Stability in Surface Mining” SME Publication 2001.
2. Vail, CO; “Rock Mechanics for Industry” Proceeding of the 37th Symposium on Rock Mechanics Vol. 1-2, ISEE Publication Cleveland, Ohio.
3. Sheory P.R., 1997; “Empirical Rock Failure Criteria” Pub. By A. A. Balkema, Rotterrdem, USA.
4. Brown E. T.; “The Nature and Fundamentals of Rock Engineering” Pub. Pergaman Press, UK.
5. Goodman R. E.; “Introduction to Rock Mechanics” Pub. John Wiley Pub. Co. Chichester.

MIP 536 Mineral Exploration Engineering

	L	P
Credit	3	0
Hours	3	0

Course Outcome

Students can get the opportunity to know various basic and advanced techniques of mineral exploration including theory, application and limitation. Also the knowledge of orebody modeling, reserve estimation and techno-economic feasibility of project are the outcome of the course.

Syllabus

Exploration: Various techniques of exploration, Various geological guides and mineral exploration, Bore hole exploration, Bore hole logging, Data generation in the form of location, elevation, assay

value etc. Ore body modeling and reserve estimation by computer software, Mineral exploration monitoring and interval, Techno-economic feasibility of exploration

References

1. Dobrin M.B.; “Introduction to geophysical Prospecting” Pub. McGRAW Hill Book Co. INC. London.
2. Mckinstry**; “**Mining Geology” Prentice Hall.
3. Haward L Hartman; “Introductory Mining Engineering” A. A. Balkema Old post Road, Publisher Old Post Road, Post Roag Brook Field USA.
4. Cummins & Givens; “SME Mining Engineering Handbook, Vol. I & II” A.I.M.M.New-York.

MIP 537 Engineering Geology in Mine Planning

	L	P
Credit	3	0
Hours	3	0

Course Outcome

Students are expected to learn the basics of Geology, Engineering Geology and, its use in mine planning and resource estimation. Also the planning and designing the underground and opencast mine through the advanced Engineering geology based softwares will also be the outcome of this course.

Syllabus

Collection and presentation of geological data, data information and facts, evaluating data and information.

Reconnaissance: Designing a reconnaissance project, map scale, airborne and satellite imagery, aerial photography and photo-geology.

Mapping surface geology: Basic maps and survey control, geologic mapping equipment, surface geologic mapping procedures.

Geologic mapping in underground mine: Special equipment, selection of geologic data, mapping format, mapping procedures, assembling geologic data, drilling for geologic information.

Sampling ore bodies and estimating reserves: Sampling methods, pattern and spacing, grade and tonnage calculation, and advanced methods of ore reserve estimation.

Mining Operations: Pre-production work, ore body re-evaluation, mine design and planning, district exploration, 3-D exploration logging, shear zone, demarcation, joint water pressure analysis.

Stereonet and stereographic projection, key block theory.

References

1. Donal M. Ragan, Structural Geology- An Introduction to Geometrical Techniques, Latest Edition. Publisher John Wiley and Sons.
2. M.P. Billings, Structural Geology. Latest Edition. Prantice Hall.
3. Swain, P.H. and Davis, S.M., 1978. Remote Sensing- The Quantitative Approach. McGraw-Hill, New York.
4. Pratt, W.K., 1978. Digital Image Processing, John Wiley & Sons, New York.
5. Mckinstry; “Mining Geology” Prentice Hall.

Ph.D. MINING ENGINEERING

CORE COURSES

MIP 611 Applied Rock Mechanics

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome

This professional course contents encourage the students to study and analyse various basic and advance aspects of designing underground structures by measurement insitu stresses and stress around mine openings. Also provide understanding of deformation and its measurement. Also provide model studies in geomechanics.

Syllabus

In-situ Stresses

In-situ stresses in the earth's crust. Methods of in-situ stress determination.

Stress Around Mine Openings

Distribution of stresses around mine openings of various shapes.

Rock Bursts and Bumps

Mechanism, prediction and control.

Rock and Rockmass Characterization

Prediction of opening behavior with empirical models.

Design of Mine Openings and Pillars

Application of various mining softwares, like FLAC, Galena, Rockscience tools.

Design of Supports and Rock Reinforcement

Rock bolting, cable bolting, roof stiching, shotcreting, support for bord and pillar and longwall workings.

Goaf Support

Mechanics of caving and filling.

Subsidence

Mechanism, prediction and control. Design of shaft pillar.

MIP 621 Safety & Risk Management in Mines

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome

This professional course contents encourage the students to study and analyse various risk, hazards and accident in mines. Also provide understanding of risk assessment process, safety audit and control, human behavioral approach.

Syllabus

Source of risk and hazard in mines.

Accident analysis and control.

Cost of accident.

System engineering approach to risk and safety.

Hazard identification techniques.

Risk assessment process. Risk reduction. Analysis with @ Risk software.

Safety audits and control.

Human behavioural approach in safety.

OPTIONAL COURSES

MIP 612 Mine Environmental Planning

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome

Students can understand the various planning aspects of environment friendly mining. Details of the course enable the student to understand basic concept of environmental impact assessment and environmental management plan. Also students should have sound knowledge of ventilation planning though network analysis and maintain good environmental condition in mines for better productivity and production.

Syllabus

Environmental Standards : National and International standards of various environmental parameters.

Environmental Impact Assessment (EIA) : Framework for EIA, screening, scoping and baseline studies. EIA methodologies and their applicability, Environmental Impact Indices, uncertainties in EIA.

Environmental Management Plan (EMP) : Scope, structure and legislative requirements. Preparation of EMP.

Ventilation Planning : Central and boundary ventilation. U, W and Z air routes. Ventilation schemes for various methods of working. Estimation of the operating pressure and air quantity requirements of mine. Selection of the main fan. Series and parallel operation of fans. Design of fan drift and evasee. Ventilation network analysis. Preparation of ventilation plans for underground mines. Control of heat and humidity through air quantity regulation and refrigeration. Control of dust, fumes and other pollutants.

MIP 613 Surface Mine Planning

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome

At present 80% of the coal production and significant proportion of other mineral output is coming from surface mines and hence students get a benefit of basic and advanced understanding of various technical and economic consideration of surface mining planning. Also the students will learn about the research and analysis in the field of advanced drilling, blasting, loading, transport and reclamation operations in surface mining.

Syllabus

Technical and Economic Consideration

Technical and economic considerations in opening up, bench formation and ultimate pit configurations.

Layout Planning

Systems of overburden removal and planning of layouts for stipulated production.

Surface Mining Equipment and Operational Planning

Overview of surface mining equipment and practices. Optimization of load-haul units. Haul road design. Computerized truck dispatch systems.

Blast Design for Fragmentation and Casting

Recent Advances in Drilling, Blasting, Loading and Transport Operations

Drainage Planning and Arrangement

Reclamation Planning

Planning for reclamation of mined out areas, open pits, waste dumps and tailings pond.

Computer Applications in Surface Mine Planning.

Application of various mining softwares, like Datamine, Surpac, Galena, FLAC, etc.

MIP 614 Underground Mine Planning

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome

Now a days there is a challenge in mining industries is to produce all the major quantity product through underground mining and hence details of planning such mines is highly solicited from the students aspiring to be a good mine manager, planner, researcher, academician, etc. Better understanding and developing analysis capabilities to the challenges in planning underground mining project is also an outcome of this course. Student can be able to plan feasibility and capacity of mine, designing of various mine entries, production planning etc. Also, underground mining is need of the hour and through this course student can get opportunity to be specialist in planning for such underground mining projects.

Syllabus

Mining Industry in India – An Overview

Characteristics of Planning Process : Scope of mining activities. Stages of mine planning.

Feasibility and Project Reports : Contents, preparation and evaluation. Preparation of mine plan and mine environmental plan.

Capacity of a Mine : Delineation of mining area. Annual output and life of the mine.

Mine Entries : Opening of single and multiple seams/veins at various inclinations – Type (shaft, incline or adit), number, location and design.

Division of Mining Area : Division of the mining area into working units on district and level pattern. Dimensions of panels and blocks.

Production Planning and Scheduling : Application of various mining softwares, like Datamine, Surpac, FLAC, etc.

MIP 615 Applied Geology in Mining

	L	T	P
Credit	2	0	1
Hours	2	0	2

Course Outcome

Students are expected to learn the applied aspects of Geology in Mining, and its use in mine planning and resource estimation. Also to learn detail aspects of geological mapping for surface and underground deposits, and ore body modeling will also be the outcome of this course.

Syllabus

Reconnaissance and Prospecting : Terrestrial, aerial and satellite imagery methods. Photo geology. Collection, presentation and evaluation of geological data.

Geological Mapping for Surface and Underground Deposits : Basic maps and survey control, equipment and procedures.

Hydro Geology : Joint water pressure analysis. Estimation of make of water.

Ore Reserve Estimation : Sampling methods, pattern spacing of holes, grade and tonnage calculation, applications of geostatistics.

Mining Operations : Ore body evaluation, district exploration, 3-D exploration logging, shear zone demarcation, joints and discontinuity survey and Joint characterization.

MIP 622 Underground Space Technology

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome

Students are expected to learn the tunnel driving techniques, design of large underground excavation and their stability analysis. Also to learn detail aspects of rock conditions, state of stresses, structural behaviour, instrumentation and monitoring & analysis aspects will also be the outcome of this course.

Syllabus

Tunnel Driving Techniques : Drilling and blasting. Tunnel boring machines. Tunnel shield supports, remote control and automation of supports. Tunneling shield system with road headers. Tunnel lining – design, reinforcement and adhesives, changes of curvature, strain and stress measurement. Rock anchoring and bolting.

Design and Construction of Large Underground Excavations : Rock conditions and initial state of stress. Dimensions, shape, structural behaviour, methods and sequence of excavations.

Power stations. Storage caverns. Metro railways. Large diameter trenches for communication, radioactive disposal and excavation for defence purposes.

Stability Analysis : Structurally controlled instability, influence of size and in-situ stresses. Instrumentation, monitoring and analysis.

Application of various mining softwares, like FLAC, etc.

MIP 623 Rock Slope Engineering

	L	T	P
Credit	2	0	1
Hours	2	0	2

Course Outcome

Students can understand the fundamentals of slope stability and then slope stability analysis in opencast mining. The understanding of the subject & slope affecting parameters and slope design capabilities are the outcome of this course.

Syllabus

Role of Slope Stability in Economic Design and Operation of Open Pit Mines

Types and Mechanics of Slope Failure: Types of slope failure, falls, slides and flows. Mechanics of slope failure – plane, wedge, circular, toppling, buckling, Prandtl type, block and key block failures.

Factors Affecting Slope Stability: Geological factors, slope geometry, ground water, equipment loading, dynamic loading and effect of time.

Slope Stability Analysis : Methods of slope stability analysis. Safety factor. Deterministic and probabilistic approaches. Physical, analytical and numerical analyses of rock and soil slopes.

Field instrumentation and monitoring. Conventional and GPS monitoring. Stabilisation and strengthening of slopes.

Design of Waste Dumps and Tailings Dams : Application of various slope stability softwares, like Galena, FLAC, etc.

MIP 624 Rock Fragmentation Engineering

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome

Mining engineers specialized in various aspects of fragmentation, blasting nuisances, special blasting techniques are expected outcome of the this course. Basic & advanced knowledge and research and analysis capabilities in the field of blast ground vibrations are also expected outcome of this course.

Syllabus

Fragmentation by Blasting : Mechanism of rock fragmentation by blasting. Explosives – trends and selection. Principles and application of explosives. Casting of rocks. Controlled blasting methods. Design of multi-row blast rounds. Design of blast rounds for tunnels and drifts.

Fragmentation Measurement Methods : Application of high speed videography and image analysis techniques for measurement of rock fragmentation by blasting, blast surveys, audits and documentation for monitoring of fragmentation. Computational methods.

Blasting Nuisances & Control : Blasting damages, ground vibrations, airblasts and flyrocks. Mitigation of damages due to blasting.

Mechanical Methods of Fragmentation : Mechanism of fragmentation by water jets, shearers and ploughs, roller and disc cutters.

Special Blasting Techniques : Underwater blasting, demolition blasting, smooth blasting and hot hole blasting.

Alternative Methods for Rock Fragmentation : Physical, chemical and nuclear methods.

Application of various fragmentation softwares, like Fragyst, etc.

MIP 625 Practices of Rock Mechanics Instrumentation

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome

Students can understand the various aspects of instrumentation used in monitoring aspects of various underground and opencast structures in mines. The understanding of various pressure and deformation measuring instruments are important. Also students should have sound knowledge of various testing equipment and instrumentation for soil mechanics for proper planning of various structures.

Syllabus

Load and Pressure Measuring Instruments : Load cells, pressure measuring instruments – stress capsules, stress meters, borehole pressure cells and flat jacks. Strain gauges and transducers, readout units, sensors, transmitters and data acquisition systems.

Deformation and Strain Measuring Instruments : Convergence meters, convergence recorders, tape extensometers, bore hole deformation gauge, multipoint borehole extensometers and bore hole camera.

Testing Equipment : UTM, MTS and acoustic emission equipment. Rock bolt pull tester. Monitoring and interpretation of the data.

Soil Mechanics : Instrumentation for shear strength and bearing capacity of soils.

Applications : Mining and Civil Engineering applications.

MINOR & SUPPORTING COURSES

MIP 616 Environmental Hazards and Disaster Management in Mines

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome

Students can understand various aspects of environmental hazards and disaster management in mines. The understanding of various mechanism of mine fires, explosions, inundation, occupational diseases and disaster management is important. Also students should have sound knowledge of investigation and analysis of environmental hazards and mine disasters.

Syllabus

Mine Fires : Mechanism of self-heating. Classes of fires. Detection, monitoring and control. Preventive and mitigative measures. Isolation, inertization and flooding. Fire fighting agents and methods.

Explosions : Types, mechanisms, prevention and recovery.

Inundation : Causes of inundation and preventive measures, detection of water bodies, precautions while approaching water bodies, water dams and barriers against failure, dewatering, case histories of inundation.

Mine Occupational Diseases : Pneumoconiosis, silicosis, asbestosis, siderosis, manganese poisoning, cyanide poisoning, heat and thermal stresses, nystagmus, radiation hazards, hazards from polyurethane, dermatitis, carbuncles, over-exertion, athelete's foot, noise induced hearing loss and white finger.

Disaster Management : Emergency organization. Developments in rescue, reviving and resuscitating apparatus. Cooling and fire resistant clothings. Location and rescue of trapped miners. Investigation of disaster. Mine rescue rules.

MIP 617 Project Management

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome

At the end of the course, the student will understand the financial analysis, project management, control and monitoring, quality management etc. Also, gain an insight into how production functions are carried out to achieve least cost combination of inputs and cost analysis. Students will be able to solve or optimize the system through understanding of network analysis, project monitoring and HRD management.

Syllabus

Financial Analysis : Mining costs. Break Even Analysis. Net Present Value (NPV). Internal Rate of Return (IRR). Incorporating risk in the NPV calculation. Sensitivity analysis. Preparation of balance sheets. Monte Carlo Simulation

Personnel Management : Requirement schedule. Qualifications, experience. Press advertisement. Processing of applications. Tests, selection and appointment. Induction and training programmes.

Work Study : Time and motion study.

Inventory Planning and Management

Purchasing and Tendering : Purchase procedures in public sector. Preparation of tender documents.

Project Monitoring : Monitoring techniques. Management Information Systems (MIS).

Industrial Disputes : Types and causes of industrial disputes. Settlement of industrial disputes.

Mine Closure Planning : Issues in mine closure planning. Different mine closure operations. Role of regulatory authorities and mine operator in mine closure. Post-mining site rehabilitation programme.

Quality Management : Concepts, practices and trends.

MIP 618 Engineering Geology

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome

Students are expected to learn the basics aspects of Engineering Geology, and its use in mine planning and resource estimation. Also the planning and designing the underground and opencast mine through mapping and interpretation of geological structures will also be the outcome of this course.

Syllabus

Genetic rock structures and their significance.

Effect of tectonic stresses on rock mass deformation. Effect of application of stress on petrographic constituents of rocks. Microfabrics and its relation with strength of rocks. Foliation and lineation in rocks and their significance.

Joints : Joint sets, joint surfaces and their characterization.

Faults : Types of faults and their characterization.

Mapping and Interpretation of Geological Structures : Equal area and stereographic projection, Pi diagrams, contour diagrams, beta diagrams, aerial photography and remote sensing.

MIP 626 Drilling Technology

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome

Drilling is an important aspect in both opencast as well as underground mines. The understanding of various drilling principles and methods are important. The students get a benefit of basic and advanced understanding of various exploratory and production drilling techniques. Also the students will learn about the research and analysis in the field of advanced drilling in mining, petroleum and construction industry.

Syllabus

Drilling Methods : Classification, factors affecting drilling of rock – thrust, rotation, flushing, feed, rock type, alignment and deviation. Flushing with air-water. Suction drilling. Basis for the choice of method – diameter, depth and rock type. Drillability of rocks. Ergonomics of drilling.

Drilling Principles : Mechanics of percussive and rotary drilling.

Exploratory Drilling : Diamond drilling – types, rods, barrels and bits. Overburden blast hole drilling. Rotary blast hole drilling – components of drilling rigs, roller bits, rigs and rock compatibility.

Production Drilling : Percussive drilling – drill design, variants, wave theory, classes of drills mounting, bit types, stems, complete failures and life.

Down-the-hole drilling – hammers, high air pressure drill string, rigs, hydraulic and pneumatic rotary heads, drilling technique.

Rotary Mining Drills : Classification, advantage, limitations and constructional features of rotary cutting and rotary crushing drill rigs.

Specialized Drilling Techniques for Mining, Petroleum and Construction Industry

MIP 627 Waste Management in Mines

	L	T	P
Credit	3	0	0
Hours	3	0	0

Course Outcome

In the present scenario, waste management in mines has become integral part of mine planning. Details of the course enable the student to understand various issues related to solid waste management, environment pollution due to mine wastes and their impact. The understanding of design aspects tailing impoundment through technical issues and analysis is also outcome of this course.

Syllabus

Chemical aspects of environmental pollution by mine wastes and their impact.

Production and characterization of solid wastes in different types of mines.

Generation and characterization of mine effluents and leachate.

Tailings – characterization, technical issues, sampling and analysis, site selection and design of tailings impoundment, tailings dam failure.

Management of different types of mine wastes.

Note:

1. For supporting courses course description, which are offered by other departments, refer separately syllabus of that particular department.
2. For syllabus of Non-Credit Compulsory Courses, see at the end.

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COMPULSORY NON-CREDIT COURSES

(Compulsory for Master's Programme in all disciplines; Optional for Ph.D. scholars)

CODE	COURSE TITLE	CREDITS
PGS 501	LIBRARY AND INFORMATION SERVICES	0+1
PGS 502	TECHNICAL WRITING AND COMMUNICATIONS SKILLS	0+1
PGS 503	INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE (e-Course)	1+0
PGS 504	BASIC CONCEPTS IN LABORATORY TECHNIQUES	0+1
PGS 505	AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES (e-Course)	1+0
PGS 506	DISASTER MANAGEMENT(e-Course)	1+0

Note: Any Two from above listed courses as proposed by the ICAR.

SYLLABUS

Library and Information Services

PGS 501 **0+1**

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modem tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information-Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

Technical Writing and Communications Skills

PGS 502 **0+1**

Objective

To equip the students/scholars with skills to write dissertations, research papers, etc. To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

Chicago Manual of Style. 14,h Ed. 1996. Prentice Hall of India.

Collins' Cobuild English Dictionary. 1995. Harper Collins.

Gordon HM & Walter J A. 1970. *Technical Writing.* 3 rd Ed. Holt, Rinehart & Winston.

Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English.* 6[1] Ed. Oxford University Press.

James HS. 1994. *Handbook for Technical Writing.* NTC Business Books.

Joseph G.2000. *MLA Handbook for Writers of Research Papers.* 5thEd. Affiliated East-West Press.

Mohan K. 2005. *Speaking English Effectively.* MacMillan India.

Richard WS. 1969. *Technical Writing.* Barnes & Noble.

Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language.* Abhishek.

Sethi J & Dhamija PV. 2004. *Course in Phonetics and Spoken English.* 2nd Ed. Prentice Hall of India.

Wren PC & Martin H. 2006. *High School English Grammar and Composition.* S. Chand & Co.

Intellectual Property and Its Management in Agriculture (e-Course)

PGS 503 **1+0**

Objective

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy. Theory Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and bio-diversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

Erbisch FH & Maredia K.1998. *Intellectual Property Rights in Agricultural technology.* CABI.

Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy.* McGraw-Hill.

Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC & Aesthetic Technologies.

Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer.* Vol. V. *Technology Generation and IPR Issues.* Academic Foundation.

Rothschild M & Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics.* CABI.

Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies.* Daya Publ. House. *The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.*

Basic Concepts in Laboratory Techniques

PGS 504 **0+1**

Objective

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; washing, drying and sterilization of glassware; Drying of solvents/chemicals. Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; Electric wiring and earthing. Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy.

Suggested Readings

Furr AK. 2000. *CRC Hand Book of Laboratory Safety.* CRC Press.

Gabb MH & Latchem WE. 1968. *A Handbook of Laboratory Solutions.*Chemical Publ. Co.

Agricultural Research, Research Ethics and Rural Development Programmes (e-Course)

PGS 505 **1+0**

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory

UNIT I

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group -Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co- operatives, Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

Bhalla GS & Singh G. 2001. *Indian Agriculture - Four Decades of Development.* Sage Publ.

Punia MS. *Manual on International Research and Research Ethics.* CCS, Haryana Agricultural University, Hisar.

Rao BSV. 2007. *Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives.* Mittal Publ.

Singh K. 1998. *Rural Development - Principles, Policies and Management.* Sage Publ.

Disaster Management (e-Course)

PGS 506 **1+0**

Objective

To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

Theory

UNIT I

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming. Sea Level rise. Ozone Depletion

UNIT II

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community- based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Readings

Gupta HK. 2003. *Disaster Management.* Indian National Scienc Academy. Orient Blackswan.

Hodgkinson PE & Stewart M. 1991. *Coping with Catastrophe: A Handbook of Disaster Management.* Routledge.

Sharma VK. 2001. *Disaster Management.* National Centre for Disaster Management, India.

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