# University of Mumbai

No. AAMS_UGS/ICC/2022-23/ \ \ \

**CIRCULAR :-**

Attention of the Principals of the Affiliated Colleges and Directors of the recognized Institutions in Faculty of Science & Technology is invited to this office circular No. UG/226 of 2016-17 dated 13th January, 2017 relating to the revised syllabus of M.E.( Water Resources Engineering) (Sem. – I & IV) (CBCS).

They are hereby informed that the recommendations made by the Board of Studies in Civil Engineering at its meeting held on 06th June, 2022 and subsequently passed in the Faculty and then by the Board of Deans at its meeting held on 5th July, 2022 vide item No. 6.20 (R) have been accepted by the Academic Council at its meeting held on 11th July, 2022 **vide** item No. 6.20 (R) and that in accordance therewith, the revised syllabus of M.E.( Water Resources Engineering) (Sem. – I to IV) (CBCS) (REV-2022 Scheme) has been brought into force with effect from the academic year 2022-23. (The circular is available on the University's website www.mu.ac.in).

(Dr. Shailendra Deolankar)
I/c Registrar

MUMBAI – 400 032
26th October, 2022

To

The Principals of the Affiliated Colleges and Directors of the recognized Institutions in Faculty of Science & Technology.

**A.C/6.20(R)/11/07/2022**

***************

No. AAMS_UGS/ICC/ 2022-23/ \ \ \ 26th October, 2022

Copy forwarded with Compliments,for information to:-

1) The Dean, Faculty of Science & Technology,
2) The Chairman, Board of Studies in Civil Engineering,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Director, Department of Information & Communication Technology,
6) The Co-ordinator, MKCL.

(Dr. Shailendra Deolankar)
I/c Registrar

Desktop/Circular of Engineering/Priya

**Copy to :-**

1. **The Deputy Registrar, Academic Authorities Meetings and Services (AAMS),**
2. **The Deputy Registrar, College Affiliations & Development Department (CAD),**
3. **The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),**
4. **The Deputy Registrar, Research Administration & Promotion Cell (RAPC),**
5. **The Deputy Registrar, Executive Authorities Section (EA),**
6. **The Deputy Registrar, PRO, Fort, (Publications Section),**
7. **The Deputy Registrar (Special Cell),**
8. **The Deputy Registrar, Fort/Vidyanagari Administration Department (FAD) (VAD), Record Section,**
10. **The Professor-cum- Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,**

**They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above circular and that on separate Action Taken Report will be sent in this connection.**

1. **P.A. to Hon'ble Vice-Chancellor,**
2. **P.A. to Pro-Vice-Chancellor,**
3. **P.A. to Registrar,**
4. **All Deans of all Faculties,**
5. **P.A. to Finance & Account Officer, (F. &. A.O.),**
6. **P.A. to Director, Board of Examination & Evaluation,**
7. **P.A. to Director, Innovation, Incubation and Linkages,**
8. **P.A. to Director, Board of Lifelong Learning and Extension (BLLE),**
9. **The Director, Dept. Of Information and Communication Technology (DICT) (CCF & UCC), Vidyanagari,**
10. **The Director of Board of Student Development,**
11. **The Director, Department of Students Welfare (DSD),**
12. **All Deputy Registrar, Examination House,**
13. **The Deputy Registrars, Finance & Accounts Section,**
14. **The Assistant Registrar, Administrative sub-campus Thane,**
15. **The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,**
16. **The Assistant Registrar, Ratnagiri Sub-centre, Ratnagiri,**
17. **The Assistant Registrar, Constituent Colleges Unit,**
18. **BUCTU,**
19. **The Receptionist,**
20. **The Telephone Operator,**
21. **The Secretary MUASA,**

**for information.**

AC – 11 July, 2022
Item No. – 6.20 (R)

# University of Mumbai

**Revised Syllabus for**

**M.E. (Water Resources Engineering)**

**(Sem. - I to IV)**

**(Choice Based Credit System)**

**(With effect from the academic year 2022-23)**

# University of Mumbai

| | |
|---|---|
| O: _____ **Title of Course** | M.E. (Water Resources Engineering) |
| O: _____ Eligibility | Passed B.E./B.Tech and as per the Ordinance 5134 |
| **R: _____ Passing Marks** | 45% |
| No. of years/Semesters: | 2 years / 4 semesters |
| Level: | P.G. / ~~U.G./~~ ~~Diploma / Certificate~~ |
| Pattern: | ~~Yearly~~ / Semester |
| Status: | ~~New~~ / Revised 2022 |
| To be implemented from Academic Year : | With effect from Academic Year : 2022-23 |

**Dr. Suresh K. Ukarande**
**Chairman,**
Board of Studies in Civil Engg.

**Dr. Suresh K. Ukarande**
**Associate Dean,**
Faculty of Science and Technology University of Mumbai

**Dr Anuradha Majumdar**
**Dean,**
Faculty of Science and Technology University of Mumbai

**Semester I**

| Course Code | Course Name | Teaching Scheme (Contact Hours) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| WRC 101 | Advanced Fluid Mechanics | 3 | -- | -- | 3 | -- | -- | 3 |
| WRC 102 | Applied Hydrology | 3 | | -- | 3 | | -- | 3 |
| WRPE101 | Program Elective 1 | 3 | -- | -- | 3 | -- | -- | 3 |
| WRPE102 | Program Elective 2 | 3 | -- | -- | 3 | -- | -- | 3 |
| WRIE101 | Institute Elective 1 | 3 | -- | -- | 3 | -- | -- | 3 |
| WRL101 | Program Lab-I | -- | 2 | -- | -- | 1 | -- | 1 |
| WRSBL101 | Skill Based Lab-I | -- | 4[$] | -- | -- | 2 | -- | 2 |
| **Total** | | **15** | **06** | **--** | **15** | **03** | **--** | **18** |

| Course Code | Course Name | Examination Scheme | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | | Term Work | Pract / Oral | Total |
| | | Internal Assessment | | | End Sem. Exam | Exam. Duration (in Hrs) | | | |
| | | Test-1 | Test-2 | Avg | | | | | |
| WRC 101 | Advanced Fluid Mechanics | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| WRC 102 | Applied Hydrology | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| WRPE101 | Program Elective 1 | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| WRPE102 | Program Elective 2 | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| WRIE101 | Institute Elective 1 | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| WRL101 | Program Lab-I | -- | -- | -- | -- | -- | 25 | 25 | 50 |
| WRSBL101 | Skill Based Lab-I | -- | -- | -- | -- | -- | 50 | 50 | 100 |
| **Total** | | **--** | **--** | **100** | **400** | -- | **75** | **75** | **650** |

**Semester II**

| Course Code | Course Name | Teaching Scheme (Contact Hours) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| WRC 201 | Water Resources Economics Planning and Management | 3 | -- | -- | 3 | -- | -- | 3 |
| WRC 202 | Design of Hydraulic Structures | 3 | | -- | 3 | | -- | 3 |
| WRPE201 | Program Elective 3 | 3 | -- | -- | 3 | -- | -- | 3 |
| WRPE202 | Program Elective 4 | 3 | -- | -- | 3 | -- | -- | 3 |
| WRIE201 | Institute Elective 2 | 3 | -- | -- | 3 | -- | -- | 3 |
| WRL201 | Program Lab-II | -- | 2 | -- | -- | 1 | -- | 1 |
| WRSBL201 | Skill Based Lab-II | -- | 4[$] | -- | -- | 2 | -- | 2 |
| **Total** | | **15** | **06** | **--** | **15** | **03** | **--** | **18** |

| Course Code | Course Name | Examination Scheme | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | | Term Work | Pract / Oral | Total |
| | | Internal Assessment | | | End Sem. Exam | Exam. Duration (in Hrs) | | | |
| | | Test-1 | Test-2 | Avg | | | | | |
| WRC 201 | Water Resources Economics Planning and Management | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| WRC 202 | Design of Hydraulic Structures | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| WRPE201 | Program Elective 3 | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| WRPE202 | Program Elective 4 | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| WRIE201 | Institute Elective 2 | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| WRL201 | Program Lab-II | -- | -- | -- | -- | -- | 25 | 25 | 50 |
| WRSBL201 | Skill Based Lab -II | -- | -- | -- | -- | -- | 50 | 50 | 100 |
| **Total** | | **--** | **--** | **100** | **400** | -- | **75** | **75** | **650** |

**Note 1:** Skill Based Lab- I and II are focused on the learning through experience. SBL shall facilitate the learner to acquire the fundamentals of practical engineering in his or her specialization in a project-oriented environment. The learning through skill-based labs can be useful in facilitating their research work and hence useful in early completion of their dissertation work.

## List of Program Electives

| Course Code | Program Elective I | Course Code | Program Elective II |
|---|---|---|---|
| **WRPE1011** | Applied Statistics | **WRPE1021** | Environmental Impact assessment |
| **WRPE1012** | Watershed Development & Management | **WRPE1022** | Soil Science & Agro Technology |
| **WRPE1013** | Ground Water Engineering | **WRPE1023** | Water shed Management |
| **Course Code** | **Program Elective III** | **Course Code** | **Program Elective IV** |
| **WRPE2011** | System Engineering and Its Application | **WRPE2021** | Integrated River Basin Management |
| **WRPE2012** | Water Power Engineering | **WRPE2022** | Soft Computing Techniques in Hydrology and Water Resources Engineering |
| **WRPE2013** | Advance Hydraulic Analysis and Design | **WRPE2023** | Advances in Irrigation Engineering |

| **Semester - I Institute Level Optional Courses (ILOC)** | |
|---|---|
| **Course Code** | **Course Name** |
| **WRIE 1011** | Product Lifecycle Management |
| **WRIE 1012** | Reliability Engineering |
| **WRIE 1013** | Management Information System |
| **WRIE 1014** | Design of Experiments |
| **WRIE 1015** | Operation Research |
| **WRIE 1016** | Cyber Security and Laws |
| **WRIE 1017** | Disaster Management and Mitigation Measures |
| **WRIE 1018** | Energy Audit and Management |
| **WRIE 1019** | Development Engineering |

| **Semester - II Institute Level Optional Courses (ILOC)** | |
|---|---|
| **Course Code** | **Course Name** |
| **WRIE 2021** | Project Management |
| **WRIE 2022** | Finance Management |
| **WRIE 2023** | Entrepreneurship Development and Management |
| **WRIE 2024** | Human Resource Management |
| **WRIE 2025** | Professional Ethics and CSR |
| **WRIE 2026** | Research Methodology |
| **WRIE 2027** | IPR and Patenting |
| **WRIE 2028** | Digital Business Management |
| **WRIE 2029** | Environmental Management |

**Semester III**

| Course Code | Course Name | Teaching Scheme (Contact Hours) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| WRMP301 | Major Project: Dissertation -I | -- | 20 | -- | -- | 10 | -- | 10 |
| **Total** | | **00** | **20** | **00** | **00** | **10** | **--** | **10** |

| Course Code | Course Name | Examination Scheme | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | | | | |
| | | Internal Assessment | | | End Sem. Exam | Exam. Duration (in Hrs) | Term Work | Pract/ Oral | Total |
| | | Test-1 | Test-2 | Avg | | | | | |
| WRMP301 | Major Project: Dissertation -I | -- | -- | -- | -- | -- | 100 | -- | 100 |
| **Total** | | **--** | **--** | **--** | **--** | -- | **100** | **--** | **100** |

**Online Credit Courses**

| Course Code | Course Name | Teaching Scheme (Contact Hours) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| WROCC301 | Online Credit Course - I | -- | -- | -- | -- | -- | -- | 3 |
| WROCC301 | Online Credit Course - II | -- | -- | -- | -- | -- | -- | 3 |
| **Total** | | **--** | **--** | **--** | **00** | **00** | **00** | **06** |

**Note 2:** It is mandatory to complete the Online Credit Courses (OCC) available on NPTEL / Swayam /MOOC or similar platform approved by UoM. These two courses shall be completed in any semester I or II or III, but not later end of the Semester III. University shall make a provision that credits earned with OCC-I and OCC-II shall be accounted in the third semester grade-sheet with actual names of courses. The learner shall be allowed to take up these courses from his or her institute or organisation/ industry where his / her major project is carried out. The students shall complete the courses and shall qualify the exam conducted by the respective authorities/ instructor from the platform. The fees for any such courses and the corresponding examination shall be borne by the learner.

**Online Credit Course – I**

The learner shall opt for the course in the domain of Research Methodology **or** Research & Publication Ethics or IPR. The opted course shall be of 3 credits of equivalent number of weeks.

**Online Credit Course –II**

The learner shall opt for the course recommended by Faculty Advisor/ Project Supervisor from the institute. The opted course shall be of 3 credits of equivalent number of weeks.

**Semester IV**

| Course Code | Course Name | Teaching Scheme (Contact Hours) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| WRMP401 | Major Project: Dissertation -II | -- | 32 | -- | -- | 16 | -- | 16 |
| **Total** | | **--** | **32** | **--** | **--** | **16** | **--** | **16** |

| Course Code | Course Name | Examination Scheme | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | | | | |
| | | Internal Assessment | | | End Sem. Exam | Exam. Duration (in Hrs) | Term Work | Pract/ Oral | Total |
| | | Test-1 | Test-2 | Avg | | | | | |
| WRMP401 | Major Project: Dissertation -II | -- | -- | -- | -- | -- | 100 | 100 | 200 |
| **Total** | | **--** | **--** | **--** | **--** | **--** | **100** | **100** | **200** |

**Total Credits: 68**

**Note 3:** The Dissertation -II submission shall not be permitted till the learner completes all the requirements ME course.

**Note 4:** The contact hours for the calculation of load of the teacher for Major Project are as follows:
Major Project Dissertation I and II - 02 Hour / week / student

**Guidelines for Dissertation-I**

Students should do literature survey and identify the problem for Dissertation and finalize in consultation with Guide/Supervisor. Students should use multiple literatures and understand the problem. Students should attempt solution to the problem by analytical/simulation/experimental methods. The solution to be validated with proper justification and compile the report in standard format. Guidelines for Assessment of Dissertation-I.

Dissertation-I should be assessed based on following points

- Quality of Literature survey and Novelty in the problem
- Clarity of Problem definition and Feasibility of problem solution
- Relevance to the specialization
- Clarity of objective and scope Dissertation-I should be assessed through a presentation by a panel of Internal examiners and external examiner appointed by the Head of the Department/Institute of respective Programme.

**Guidelines for Assessment of Dissertation II**

Dissertation II should be assessed based on following points:

- Quality of Literature survey and Novelty in the problem
- Clarity of Problem definition and Feasibility of problem solution
- Relevance to the specialization or current Research / Industrial trends
- Clarity of objective and scope
- Quality of work attempted or learner contribution

- Validation of results
- Quality of Written and Oral Presentation

Students should publish at least one paper based on the work in referred National/ International conference/Journal of repute.

Dissertation II should be assessed by internal and External Examiners appointed by the University of Mumbai.

| Semester I | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRC 101** | **Advanced Fluid Mechanics** | **03** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| **03** | **--** | **--** | **03** | **--** | **--** | **03** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| **20** | **20** | **20** | **80** | **03 Hrs.** | **--** | **--** | **---** | **100** |

| Detailed Syllabus | | |
|---|---|---|
| **Module** | **Content** | **Contact Hours** |
| 1 | **Ideal fluid motion**<br><br>Review of Fluid mechanics, Kinematics of fluid flow, stream functions and potential functions, Laplace equation and its solution by graphical and relaxation methods, flow nets, dynamics of fluid flow, Euler's equation, application of ideal fluid motion, Source and Sink, Free vortex flow, Source and Uniform flow, Superimposed flow patterns, Source-Sink pair, Source and Sink pair in a uniform flow, Doublet, Flow past a Rankine oval body, Magnus effect, Kutta Joukowski transformation. | 8 |
| 2 | **Laminar, Transition and Turbulent flow**<br><br>**Laminar Flow:** Concept and characteristics of laminar flow, Navier-Stokes equations, creeping motion, approximate and exact solutions.<br><br>**Transition flow:** Concept of stability, stability theories, factors affecting transition, Rouse Index<br><br>**Turbulent flow:** Classification and characteristics of turbulent flows, statistical approach, Reynolds equations, Reynolds Average N-S (RANS) Equation, Statistical theories of turbulence, turbulence models, Coherent Structures and Turbulent bursting. | 10 |
| 3 | **Boundary Flows:** Boundary layer concepts, Boundary layer parameters, Prandtl'sboundary layer equations, Blassius solution for laminar boundary layer flows, von-Karman Momentum integral equation and its applications, Laminar boundary layer, Turbulent boundary layer flows, Laminar sub layer, Boundary layer separation and controls. | 8 |

| | | |
|---|---|---|
| 4 | **Unsteady open channel flow**<br><br>Wave celerity, classification of water waves according to relative depth, orbital motions,<br><br>superposition, wave trains and wave energy, transformation of waves, dissipation of wave<br><br>energy, positive and negative surges in rectangular channel, Momentum and Continuity<br><br>Equations (Saint Venant Equation), two dimensional unsteady flows. | 8 |
| 5 | **Spatially varied flow**<br><br>Basic principles and assumptions, dynamic equation and analysis of flow profiles, Numerical integration method, Isoclinal method, spatially varied steady and unsteady surface flows.<br><br>**Introduction:** Hydrodynamic and Pollutant transfer in open channel | 5 |

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is eithera class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part

(b) will be from any module other than module 3)

4. Only Four question need to be solved.

**Recommended Books:**


1. Applied Hydrodynamics: H.R. Vallentine, ELBS Publication.
2. Fluid Mechanics: Grade & Mirajgaonkar.
3. Fluid Mechanics: Victor L Streeter & E.B. Wylie, Mc-Graw HillViscous Fluid Flow:Frank M White, Mc-Graw Hill.
4. Fluid Mechanics and Hydraulics: Dr. S.K. Ukrande, Ane's Books Pvt. Ltd. (Revised Edition, 2012), ISBN 97893 8116 2538.
5. Fluid Mechanics. Kumar, D.S. S.K. Kataria & Sons Publishers, New Delhi, 1998.
6. Fluid Mechanics and Hydraulic Machines: R. K. Bansal, Laxmi Publications (P) Ltd., New,Delhi, 2000.
7. Turbulent Flow: Garde, R.J. New Age International (P) Ltd. Publishers, New Delhi, 2005.
8. Fluid Dynamics: Daiy and Harleman, Addition Wesley, New York, 1973.

9. Fluid Mechanics: R.A. Granger Dover Publications, New York, 1995.
10. Ranga Raju K.G.,Flow through Open Channels, TATA MC Graw-Graw-Hill publishing Company Limited, 1997.
11. Chow V T, Open Channel Hydraulics, McGraw-Hill Book Company, International editions, New Delhi, 1973.

| Semester I | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRC 102** | **Applied Hydrology** | **03** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| **03** | **--** | **--** | **03** | **--** | **--** | **03** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| **20** | **20** | **20** | **80** | **03 Hrs.** | **--** | **--** | **---** | **100** |

| Detailed Syllabus | | |
|---|---|---|
| **Module** | **Content** | **Hours** |
| 1 | **Introduction:** Introduction to hydrology, hydrological cycle. | 02 |
| 2 | **Precipitation:** Definition, types and forms of precipitation, precipitation gauges, analysis of data, supplementing missing data, consistency of record, hyetograph, mass curve analysis, depth areas duration analysis. Rainfall frequency analysis. | 04 |
| 3 | **Evapotranspiration**: Introduction to Evaporation, transpiration, evapotranspiration, Factors affecting, measurement, network design, estimation of evaporation and evapotranspiration, evaporation retardation. | 06 |
| 4 | **Infiltration**: Capacity, rates and indices, factors affecting, measurement of infiltration, estimation of infiltration capacity from hydrograph analysis. | 04 |
| 5 | **Hydrometry:** Measurement of discharge, selection of site for stage and discharge measuring station non-recording and recording gauges, accuracy and frequency of observed data, discharge measurement by area velocity method and slope area method. | 06 |
| 6 | **Runoff:** Runoff, components of runoff, factors affecting runoff, storage effects of runoff from snowmelt, estimation of average monthly and annual runoff, determination of rainfall - runoff relationships by various methods. | 06 |
| 7 | **Hydrograph**: Introduction to hydrograph, Master recession curve, base flow and its separation, unit hydrograph theory and its application for isolated and complex storms , synthetic unit hydrograph, S- curve, unit hydrograph of varied durations, instantaneous unit hydrograph, conceptual hydrograph. | 06 |
| 8 | **Design flood:** Rational and empirical relationships, flood frequency analysis, recurrence interval design. | 03 |

| | | |
|---|---|---|
| 9 | **Introduction to Flood routing**: Reservoirs and channels routing. | 02 |

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is eithera class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part

(b) will be from any module other than module 3)

4. Only Four question need to be solved.

**Recommended Books:**


1. Chow Ven-Te, Maidment, David R. and Mays Larry W., "Applied Hydrology" Mc Graw hill Publications, 1995.
2. Singh V. P., "Elementary Hydrology", prentice hall of India, 1994.
3. Ragunath H.M., "Hydrology", Wily Eastern Ltd, 1996.
4. Subramanya K. "Engineering hydrology". Tata Mc-Graw Hill, 3rd edition, 2009.
5. Jayarami Reddy P., "Stochastic Hydrology" Laxmi Publications, New Delhi 1995.

| Semester I | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRPE1011** | **Program Elective 1: Applied Statistics** | **03** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| **03** | **--** | **--** | **03** | **--** | **--** | **03** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| **20** | **20** | **20** | **80** | **03 Hrs.** | **--** | **--** | **---** | **100** |

| Detailed Syllabus | | |
|---|---|---|
| **Module** | **Content** | **Contact Hours** |
| 1 | **Basic Concepts of Probability Theory:** Probability, random variables, moments, moment generating functions, standard distributions, two dimensional random variables, central limit theorem. | 6 |
| 2 | **Estimation Theory:** Principle of least squares – regression and correlation (multiple and partial), estimation of parameters – maximum likelihood estimates – method of moments. | 6 |
| 3 | **Testing of Hypothesis: Sampling distributions:** Tests based on normal. Chi-square and F- distributions, analysis of variance – one way and two way classifications**.** | 8 |
| 4 | **Random Process:** Classification – stationary random process, Markov process, Markov chains, Poisson process, birth and death process, simple queuing applications | 6 |
| 5 | **Time Series:** Characteristics and representation, moving averages, exponential smoothing, auto regressive process, other related models, study of time series plots and scatter plots. | 7 |
| 6 | **Laplace transform:** Laplace transforms of elementary functions, shifting theorem, change of scale property, Inverse Laplace transforms, Laplace transforms of derivatives, Laplace transforms of integrals. | 6 |

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is eithera class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part

(b) will be from any module other than module 3)

4. Only Four question need to be solved.

**Recommended Books:**


1. Anderson O. D. and Perryman M. R., "Time Series Analysis", North-Holland, Amesterdam, 1981.
2. Anderson, O. D., "Time Series Analysis, Theory and Practice I", North-Holland Amsterdam, 1982.
3. Bhat U.N., "Elements of Applied Stochastic Processes", Wiley Series in Probability and Mathematical Statistics, Second Edition, 1984.
4. Fruend, John E. and Miller Irwin, "Probability and Statistics for Engineers", Prentice Hall, 1980.
5. John, B., Kennedy and Adam, M. Neville, "Basic Statistical Methods" Harper and Row Publishers, New York, 1986.
6. Spiegel, "Laplace Transform" (Schaum Series).
7. Srinivasan, S. K., and Mehta, K.M., "Probability and Random Processes", Tata Mc Graw Hill, 1981.

| Semester I | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRPE1012** | **Program Elective 1: Watershed Development and Management** | **03** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| **03** | **--** | **--** | **03** | **--** | **--** | **03** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| **20** | **20** | **20** | **80** | **03 Hrs.** | **--** | **--** | **---** | **100** |

| Detailed Syllabus | | |
|---|---|---|
| **Module** | **Content** | **Contact Hours** |
| 1 | **Introduction to watershed:** Concept, significance of geology, soil and morphological characteristics, land capability classification, delineation, codification, factors influencing, watershed development. Fundamental concepts of geomorphology, geomorphic agents and processes, weathering and soil processes. | 9 |
| 2 | **Soil Conservation Practice:** Types of Erosion- causes, factors, effects and control, water erosion: engineering measures for erosion control in agricultural and non-agricultural lands, estimation of soil loss, water harvesting techniques, design of small water harvesting structures, types of storage structures, yield from a catchment. | 10 |
| 3 | **Watershed Management:** Strategies, identification of problems, watershed development, plan entry point activities, concept of priority watersheds, agro forestry, grassland management, wasteland management, watershed approach in government programmes developing collaborative know how, people's participation, evaluation of watershed management. | 12 |
| 4 | **Watershed Assessment Models-**Regulation and restoration, a brief description and significance of watershed models: SWAT, TMDL, AGNPS, BASINS, and CREAMS – Case Studies. | 08 |

**Assessment:**
**Internal:**
Assessment consists of two tests out of which; one should be compulsory class test and the other is eithera class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part

(b) will be from any module other than module 3)

4. Only Four question need to be solved.

**Recommended Books:**


1. Paul, Debarry A., "Watersheds", Wiley and Sons, 2004.
2. Devanport E. Thomas, "Watershed Project Management Guide", Lewis Publishers, London, 2003.
3. Das, Ghanashyam., "Hydrology and Soil Conservation engineering", Prentice Hall of India Private Limited, New Delhi, 2000.
4. Glenn O. Schwab, "Soil and Water Conservation Engineering", John Wiley and Sons, 1981.
5. Singh, Gurmail, "A Manual on Soil and Water Conservation", ICAR Publication, New Delhi, 1982.
6. Suresh, R., "Soil and Water Conservation Engineering", Standard Publication, New Delhi, 1982.
7. Thornbury, W.D., "Principles of Geomorphology", Wiley, 1968.

| Semester I | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRPE1013** | **Program Elective 1: Ground Water Engineering** | **03** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| **03** | **--** | **--** | **03** | **--** | **--** | **03** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| **20** | **20** | **20** | **80** | **03 Hrs.** | **--** | **--** | **---** | **100** |

| Detailed Syllabus | | |
|---|---|---|
| **Module** | **Content** | **Contact Hours** |
| 1 | **Introduction:** Ground water occurrence and its role in Hydrological cycle, geological formations such as aquifers; types of aquifers, ground water movement, Darcy's law, permeability and its measurement, tracing of ground water movement, fundamental equations for steady and unsteady ground water flow, flow nets. | 09 |
| 2 | **Well hydraulics:** Steady and unsteady flow in confined, semi-confined and unconfined aquifers, radial flow, superposition, interference among the wells. Different methods of well construction; construction of well casings and screens, natural and artificial gravel packed wells. Safe yields, estimation, pumping and recuperation tests. Infiltration galleries, ground-water replenishment, recharge of ground water, different ground water recharge methods. | 12 |
| 3 | **Groundwater modelling:** Physical models, analog models, mathematical modelling, unsaturated flow models. Introduction to numerical models of groundwater flow, finite differential equations, finite difference solution applicable in ground water modelling. | 12 |
| 4 | **Salt water intrusion:** Concept; interface and its location, control of intrusion, pollutant transport, Plume Transport, source identification, tracer | 06 |

| | | |
|---|---|---|
| | methods, and artificial recharge, remedial measures to prevent salt-water intrusion. | |

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is eithera class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part

(b) will be from any module other than module 3)

4. Only Four question need to be solved.

**Recommended Books:**


1. Todd David Keith, "Groundwater Hydrology", John Wiley publishers, 2004.
2. Jacob and Bear, "Hydraulics of Groundwater", McGraw Hill, 1997.
3. Mutreja K.N., "Applied Hydrology", Tata McGraw-Hill Publishing company Ltd., New Delhi, 1990.
4. Raghunath, "Groundwater & Well Hydraulics", Wiley Eastern Ltd, New Delhi, 1992Singh V. P., "Elementary Hydrology", Prentice Hall, INDIA.(1992).

Walton W.C, "Groundwater Modelling Utilities", Lewis Publications, Boca-Raton, 1992.

| Semester I | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRPE1021** | **Program Elective 2: Environmental Impact Assessment** | **03** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| **03** | **--** | **--** | **03** | **--** | **--** | **03** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| **20** | **20** | **20** | **80** | **03 Hrs.** | **--** | **--** | **---** | **100** |

| Detailed Syllabus | | |
|---|---|---|
| **Module** | **Content** | **Hours** |
| 1 | **Concept of environmental impact analysis:** Legislations, laws and acts relevant to environmental protection in India – factors for consideration in assessing environmental impacts- measurement of environmental impacts, short term and long-term effects. Socioeconomic impact analysis, types of socioeconomic impacts, outline of the basic steps in performing socioeconomic impact assessment. | 10 |
| 2 | **Air quality impact analysis:** Air pollutants-sources, atmospheric interaction- environmental impact assessment methodology, noise impact analysis- typical considerations, environmental impacts and effects of noise on people, control of noise pollution. | 10 |
| 3 | **Water quality impact analysis:** Water quality criteria and standards, environmental. - water quality impacts by projects like highways, power plants, mining, agriculture and irrigation, forest management. energy impact analysis- energy impact considerations, organization and methodology. | 10 |
| 4 | **Vegetation and wildlife impact analysis:** Environment assessment, methodologies, summarization of environmental, impact checklist method, matrix method, and network method. | 9 |

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is eithera class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part

(b) will be from any module other than module 3)

4. Only Four question need to be solved.

**Recommended Books:**


1. John G. Rau and David C. Wooten. ‐Environmental Impact Analysis‖ Handbook.
2. Canter, Environmental Impact Assessment

| Semester I | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRPE1022** | **Program Elective 2: Soil Science & Agro-Technology** | **03** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| **03** | **--** | **--** | **03** | **--** | **--** | **03** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| **20** | **20** | **20** | **80** | **03 Hrs.** | **--** | **--** | **---** | **100** |

| Detailed Syllabus | | |
|---|---|---|
| **Module** | **Content** | **Contact Hours** |
| 1 | **Classification of soils:** Types of soils and characteristics of soils with special significance with reference to agricultural use. | 6 |
| 2 | **Properties of Soils:** Physical, chemical and biological properties of soils and their utility in crop production, Types of fertilizers and their reactions, preparation of soil maps; crop production potential. Principles of crop production, inputs to crop productions. | 6 |
| 3 | **Weeds and methods of weed control:** Preventive, cultural, chemical, biological and mechanical control of weeds, soil fertilizer doses as per optimum requirement. | 8 |
| 4 | **Crop Physiology:** Introduction and principle of crop physiology, Growth and development, seed physiology, vegetative propagation, micro propagation, physiology associated with grafting and rootstocks. Plant and crop stand photosynthesis, Effects of photoperiod, temperature, light intensity and light quality on plant growth and development. Stress physiology related to environmental factors, introduction to growth analysisand simple forecasting systems. | 6 |
| 5 | **Dry Land Farming**: Introduction to Dry land, dry land agricultural, dryland crops, drought, dry farming, characteristics of dry land agricultural. | 7 |
| 6 | **Agro climatology of crop planning:** Principles of agro climatology weather elements, climatic elements-and their diurnal, seasonal, and annual variations and its variability. climatology with graphs, maps and atlas showing distribution of pressure, wind, temperature, rainfall, evaporation, radiation and dew, with special reference to climatology of India, water requirement of crops. | 6 |

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is eithera class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part

(b) will be from any module other than module 3)

4. Only Four question need to be solved.

**Recommended Books:**


1. Foth H.D. and Turk L.M., –Fundamentals of soil science‖ Wiley publication.
2. Miller R.W. and Donahue R.L. –An introduction to soil and plant growth‖ 6th edition, Englewood Cliffs N.J. Prentice Hall
3. Misra R.D. and Ahmed M., ―Manual on Irrigation Agronomy‖ Oxford & IBH Pub.

| Semester I | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRPE1023** | **Program Elective 2: Watershed Management** | **03** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| **03** | **--** | **--** | **03** | **--** | **--** | **03** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| **20** | **20** | **20** | **80** | **03 Hrs.** | **--** | **--** | **---** | **100** |

| Detailed Syllabus | | |
|---|---|---|
| **Module** | **Content** | **Contact Hours** |
| 1 | **Soil Erosion & Its Control**: Basic concepts of soil erosion; Factors affecting soil erosion; Types of erosion: Water erosion, Wind erosion, Gully erosion and Stream bank erosion; Models for estimating soil erosion losses (USLE); Climate change and soil erosion risk; Soil erosion control structures and their design: Contour bunding, Graded bunding, Bench terracing and Contour trenching. | 6 |
| 2 | Soil & Water Conservation: Need of soil and water conservation; Soil survey; Water harvesting techniques: Farm Ponds & Percolation Tanks: Selection of site, Survey & Design; Design and construction of Cement Nalla Bandhara (CNB) structures. | 6 |
| 3 | Hydrology of Watershed: Hydrological processes in watershed; Hydrologic Modeling of watershed; Estimation of peak design runoff rate: (Rational method and Curve number method). | 8 |
| 4 | Watershed Development & Management: Watershed development: Ridge to Valley Concept; Watershed characteristics; Watershed delineation; Land use capability classification. | 6 |
| 5 | Irrigation System Management: Irrigation system management; Design of irrigation quality management system; Participative irrigation management. | 7 |
| 6 | : Land Grading & Drainage: Land grading survey and design: (Plane and Profile methods); Drainage design criteria & drainage equations; Design, construction & maintenance of surface and subsurface drainage systems. | 6 |

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is eithera class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part

(b) will be from any module other than module 3)

4. Only Four question need to be solved.

**References:**

1. Fangmeier, W., Elliott, W.J., Workman, S., Huffman, R. and Schwab, G.O. 2005, Soil and Water Conservation Engineering, 5th Edition, Cengage Learning, Inc., Clifton Park, USA.
2. Murthy, V.V.N., 2002, Land and Water Management Engineering. 4th Edition, Kalyani Publishers, New Delhi.
3. Suresh, R., 2004, Soil and Water Conservation Engineering, Standard Publishers, New Delhi.

| Semester I | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRIE1011** | **Institute Level Elective: Product Lifecycle Management** | **03** |

**Teaching Scheme**

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

**Evaluation Scheme**

| Theory | | | | | Term work / Practical / Oral | | | **Total Marks** |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End SemExam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hrs. | -- | -- | -- | 100 |

**Objectives:**

- To familiarize the students with the need, benefits and components of PLM
- To acquaint students with Product Data Management & PLM strategies
- To give insights into new product development program and guidelines for designing and developing a product
- To familiarize the students with Virtual Product Development

| Module | Detailed Contents | Hrs |
|---|---|---|
| **I** | **Introduction to Product Lifecycle Management (PLM):** Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM | 10 |
| **II** | **Product Design:** Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product DevelopmentProcess, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design | 09 |

| | | |
|---|---|---|
| | for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process | |
| **III** | **Product Data Management (PDM):** Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation | 05 |
| **IV** | **Virtual Product Development Tools:** For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies | 05 |
| **V** | **Integration of Environmental Aspects in Product Design:** Sustainable Development, Design for Environment,Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design | 05 |
| **VI** | **Life Cycle Assessment and Life Cycle Cost Analysis:** Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis | 05 |

**Contribution to Outcomes:**

Students will be able to

- Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility studyand PDM implementation.
- Illustrate various approaches and techniques for designing and developing products.
- Apply product engineering guidelines / thumb rules in designing products for moulding, machining,sheet metal working etc.
- Acquire knowledge in applying virtual product development tools for components, machining andmanufacturing plant

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is either aclass test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional tonumber of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part

(b) will be from any module other than module 3)

4. Only Four question need to be solved.

**References:**

1. John Stark, “Product Lifecycle Management: Paradigm for 21st Century Product Realisation”, Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, AntoninoRisitano, “Product Design for the environment-A life cycle approach”, Taylor & Francis 2006, ISBN: 0849327229
3. SaaksvuoriAntti, ImmonenAnselmie, “Product Life Cycle Management”, Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, “Product Lifecycle Management: Driving the next generation of lean thinking”, Tata McGraw Hill, 2006, ISBN: 0070636265

| Semester I | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRIE1012** | **Institute Level Elective: Reliability Engineering** | **03** |

**Teaching Scheme**

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

**Evaluation Scheme**

| Theory | | | | | Term work / Practical / Oral | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hrs. | -- | -- | -- | 100 |

**Objectives**

- To familiarize the students with various aspects of probability theory
- To acquaint the students with reliability and its concepts
- To introduce the students to methods of estimating the system reliability of simple and complex systems
- To understand the various aspects of Maintainability, Availability and FMEA procedure

| Module | Detailed Contents | Hrs |
|---|---|---|
| **I** | **Probability theory:** Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem.<br>**Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance.<br>**Measures of Dispersion:** Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis. | 08 |
| **II** | **Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve.<br>**Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions.<br>**Reliability Hazard Models:** Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis. | 08 |
| **III** | **System Reliability:** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems. | 05 |
| **IV** | **Reliability Improvement:** Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis.<br>System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method. | 08 |

| | | |
|---|---|---|
| **V** | **Maintainability and Availability:** System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement.<br>Availability – qualitative aspects. | 05 |
| **VI** | **Failure Mode, Effects and Criticality Analysis:** Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis | 05 |

**Outcomes**

Students will be able to…

- Understand and apply the concept of Probability to engineering problems
- Apply various reliability concepts to calculate different reliability parameters
- Estimate the system reliability of simple and complex systems
- Carry out a Failure Mode Effect and Criticality Analysis

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

**References:**


1. L.S. Srinath, "Reliability Engineering", Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Conor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

| Semester I | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRIE1013** | **Institute Level Elective: Management Information System** | **03** |

**Teaching Scheme**

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

**Evaluation Scheme**

| Theory | | | | | Term work / Practical / Oral | | | **Total Marks** |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hrs. | -- | -- | -- | 100 |

**Objectives:**

- The course is blend of Management and Technical field.
- Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
- Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
- Identify the basic steps in systems development

| Module | Detailed Contents | Hrs |
|---|---|---|
| **I** | Introduction to Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS. | 4 |
| **II** | Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management.<br>Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results | 7 |
| **III** | Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls | 7 |
| **IV** | Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce. | 7 |
| **V** | Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model. | 6 |
| **VI** | Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process.<br>Acquiring Information Systems and Applications: Various System development life cycle models. | 8 |

**Contribution to Outcomes**

Students will be able to:

- Explain how information systems Transform Business
- Identify the impact information systems have on an organization
- Describe IT infrastructure and its components and its current trends
- Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
- Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is either aclass test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part

(b) will be from any module other than module 3)

4. Only Four question need to be solved.

**References:**


1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

| Semester I | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRIE1014** | **Institute Level Elective: Design of Experiments** | **03** |

**Teaching Scheme**

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

**Evaluation Scheme**

| Theory | | | | | Term work / Practical / Oral | | | **Total Marks** |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hrs. | -- | -- | -- | 100 |

**Objectives:**

- To understand the issues and principles of Design of Experiments (DOE)
- To list the guidelines for designing experiments
- To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

| Module | Detailed Contents | Hrs |
|---|---|---|
| **I** | **Introduction**<br>1.1 Strategy of Experimentation<br>1.2 Typical Applications of Experimental Design<br>1.3 Guidelines for Designing Experiments<br>1.4 Response Surface Methodology | 06 |
| **II** | **Fitting Regression Models**<br>2.1 Linear Regression Models<br>2.2 Estimation of the Parameters in Linear Regression Models<br>2.3 Hypothesis Testing in Multiple Regression<br>2.4 Confidence Intervals in Multiple Regression<br>2.5 Prediction of new response observation<br>2.6 Regression model diagnostics<br>2.7 Testing for lack of fit | 08 |
| **III** | **Two-Level Factorial Designs**<br>3.1 The $2^2$ Design<br>3.2 The $2^3$ Design<br>3.3 The General$2^k$ Design<br>3.4 A Single Replicate of the $2^k$ Design<br>3.5 The Addition of Center Points to the $2^k$ Design,<br>3.6 Blocking in the $2^k$ Factorial Design<br>3.7 Split-Plot Designs | 07 |

| | | |
|---|---|---|
| **IV** | **Two-Level Fractional Factorial Designs**<br>4.1 The One-Half Fraction of the $2^k$ Design<br>4.2 The One-Quarter Fraction of the $2^k$ Design<br>4.3 The General $2^{k-p}$ Fractional Factorial Design<br>4.4 Resolution III Designs<br>4.5 Resolution IV and V Designs<br>4.6 Fractional Factorial Split-Plot Designs | 07 |
| **V** | **Response Surface Methods and Designs**<br>5.1 Introduction to Response Surface Methodology<br>5.2 The Method of Steepest Ascent<br>5.3 Analysis of a Second-Order Response Surface<br>5.4 Experimental Designs for Fitting Response Surfaces | 07 |
| **VI** | **Taguchi Approach**<br>6.1 Crossed Array Designs and Signal-to-Noise Ratios<br>6.2 Analysis Methods<br>6.3 Robust design examples | 04 |

**Contribution to Outcomes**

Students will be able to

- Plan data collection, to turn data into information and to make decisions that lead to appropriate action
- Apply the methods taught to real life situations
- Plan, analyze, and interpret the results of experiments

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

**References:**


1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition,John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

| Semester I | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRIE1015** | **Institute Level Elective: Operation Research** | **03** |

**Teaching Scheme**

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

**Evaluation Scheme**

| Theory | | | | | Term work / Practical / Oral | | | **Total Marks** |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Avg | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hrs. | -- | -- | -- | 100 |

**Objectives:**

- Formulate a real-world problem as a mathematical programming model.
- Understand the mathematical tools that are needed to solve optimization problems.
- Use mathematical software to solve the proposed models.

| Module | Detailed Contents | Hrs |
|---|---|---|
| **I** | **Introduction to Operations Research**: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research<br>**Linear Programming**: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, **Duality**, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis<br>**Transportation Problem**: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method.<br>**Assignment Problem**: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem<br>**Integer Programming Problem**: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms. | 14 |

| | | |
|---|---|---|
| **II** | **Queuing models**: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population | 05 |
| **III** | **Simulation**: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation | 05 |
| **IV** | **Dynamic programming**. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems. | 05 |
| **V** | **Game Theory**. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games. | 05 |
| **VI** | **Inventory Models**: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model, | 05 |

**Outcomes:**

Students will be able to

- Understand the theoretical workings of the simplex method, the relationship between a linearprogram and its dual, including strong duality and complementary slackness.
- Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
- Understand the applications of integer and a queuing model and programming

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

**References:**


1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

| Semester I | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRIE1016** | **Institute Level Elective: Cyber Security and Laws** | **03** |

**Teaching Scheme**

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

**Evaluation Scheme**

| Theory | | | | | Term work / Practical / Oral | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hrs. | -- | -- | -- | 100 |

**Objectives:**

- To understand and identify different types cybercrime and cyber law
- To recognized Indian IT Act 2008 and its latest amendments
- To learn various types of security standards compliances

| Module | Detailed Contents | Hrs |
|---|---|---|
| **I** | **Introduction to Cybercrime:** Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes. | 4 |
| **II** | **Cyber offenses & Cybercrime:** How criminal plan the attacks, Social Engg, Cyber stalking, Cybercafé and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops | 9 |
| **III** | **Tools and Methods Used in Cyberline** Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft) | 6 |
| **IV** | **The Concept of Cyberspace** E-Commerce, The Contract Aspects in Cyber Law, The Security Aspect of Cyber Law, The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law, The Criminal Aspect in Cyber Law, Global Trends in Cyber Law, Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking, The Need for an Indian Cyber Law | 8 |

| | | |
|---|---|---|
| **V** | **Indian IT Act.**<br>Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments | 6 |
| **VI** | **Information Security Standard compliances**<br>SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI. | 6 |

**Outcomes**

Students will be able to:

- Understand the concept of cybercrime and its effect on outside world
- Interpret and apply IT law in various legal issues
- Distinguish different aspects of cyber law
- Apply Information Security Standards compliance during software design and development

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination.

**In question paper weightage of each module will be proportional to number of respective lecturehours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

**References:**


1. Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, Information Systems Security, Wiley India, New Delhi
6. Kennetch J. Knapp, Cyber Security &Global Information Assurance Information Science Publishing.
7. William Stallings, Cryptography and Network Security, Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
9. Website for more information , A Compliance Primer for IT professional : https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

| Semester I | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRIE1017** | **Institute Level Elective: Disaster Management and Mitigation Measures** | **03** |

**Teaching Scheme**

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

**Evaluation Scheme**

| Theory | | | | | Term work / Practical / Oral | | | **Total Marks** |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hrs. | -- | -- | -- | 100 |

**Objectives**

- To understand physics and various types of disaster occurring around the world
- To identify extent and damaging capacity of a disaster
- To study and understand the means of losses and methods to overcome /minimize it.
- To understand role of individual and various organization during and after disaster
- To understand application of GIS in the field of disaster management
- To understand the emergency government response structures before, during and after disaster

| Module | Detailed Contents | Hrs |
|---|---|---|
| **I** | **Introduction**<br>**1.1** Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change. | **03** |
| **II** | **Natural Disaster and Manmade disasters:**<br>2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion<br>2.2 Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters. | **09** |
| **III** | **Disaster Management, Policy and Administration**<br>3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management.<br>3.2 Policy and administration:<br>Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and | **06** |

| | | |
|---|---|---|
| | how to proceed in due course of time, study of flowchart showing the entire process. | |
| **IV** | **Institutional Framework for Disaster Management in India:**<br>4.1 Importance of public awareness, Preparation and execution of emergency management programme.Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations.<br>4.2 Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard. | **06** |
| **V** | **Financing Relief Measures:**<br>5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams.<br>5.2 International relief aid agencies and their role in extreme events. | **09** |
| **VI** | **Preventive and Mitigation Measures:**<br>6.1 Pre-disaster, during disaster and post-disaster measures in some events in general<br>6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication<br>6.3 Non-Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans.<br>6.4 Do's and don'ts in case of disasters and effective implementation of relief aids. | **06** |

**Outcomes:**

Students will be able to…

- Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
- Plan of national importance structures based upon the previous history.
- Get acquainted with government policies, acts and various organizational structure associated with an emergency.
- Get to know the simple do's and don'ts in such extreme events and act accordingly.

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

**References:**


1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elseveir Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.

(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

| Semester I | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRIE1018** | **Institute Level Elective: Energy Audit and Management** | **03** |

**Teaching Scheme**

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

**Evaluation Scheme**

| Theory | | | | | Term work / Practical / Oral | | | **Total Marks** |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hrs. | -- | -- | -- | 100 |

**Objectives:**

- To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
- To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
- To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

| Module | Detailed Contents | Hrs |
|---|---|---|
| **I** | **Energy Scenario:**<br>Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance | 04 |
| **II** | **Energy Audit Principles:**<br>Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis.<br>Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR) | 08 |
| **III** | **Energy Management and Energy Conservation in Electrical System:**<br>Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings.**Energy efficiency measures in lighting system, Lighting control:** Occupancy sensors, daylight integration, and use of intelligent controllers.<br>Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives. | 10 |

| | | |
|---|---|---|
| **IV** | **Energy Management and Energy Conservation in Thermal Systems:**<br>Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system.<br>General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities. | 10 |
| **V** | **Energy Performance Assessment:**<br>On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis. | 04 |
| **VI** | **Energy conservation in Buildings:**<br>Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources | 03 |

**Outcomes:**

Students will be able to:

- To identify and describe present state of energy security and its importance.
- To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
- To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
- To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
- To analyze the data collected during performance evaluation and recommend energy saving measures

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

5. Question paper will comprise of total six question
6. All question carry equal marks
7. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
8. Only Four question need to be solved.

**References:**


1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons

4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy ResearchInstitute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

| Semester I | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WREIE 1019** | **Institute Level Optional Course – I: Development Engineering** | **03** |

**Teaching Scheme**

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

**Evaluation Scheme**

| Theory | | | | | Term work / Practical / Oral | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Avg | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hrs. | -- | -- | -- | 100 |

**Objectives:**

1. To understand the characteristics of rural Society and the Scope, Nature and Constraints of rural Development
2. To study Implications of 73rd CAA on Planning, Development and Governance of Rural Areas
3. An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals
4. To understand the Nature and Type of Human Values relevant to Planning Institutions

| Module | Detailed Contents | Hrs. |
|---|---|---|
| **I** | Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services. | **08** |
| **II** | Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development. | **04** |
| **III** | Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; | **06** |

| | | |
|---|---|---|
| | Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the<br>weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development. | |
| **IV** | Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and<br>rural planning; Need for further amendments. | **04** |
| **V** | Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education.<br>Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity,<br>love and wisdom. | **10** |
| **VI** | Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education | **04** |

**Outcomes: Learner will be able to…**

1. Apply knowledge for Rural Development.
2. Apply knowledge for Management Issues.
3. Apply knowledge for Initiatives and Strategies
4. Develop acumen for higher education and research.
5. Master the art of working in group of different nature.
6. Develop confidence to take up rural project activities independently

**Assessment:**

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module

3 then part (b) will be from any module other than module 3)

4. **Only Four questions need to be solved**

**Reference**


1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday.
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.
9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150.
10. Watson, V. , Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395 – 407

| Semester I | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WREL101** | **Program Lab-I** | **02** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| **---** | **2** | **---** | **---** | **1** | **---** | **02** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| **---** | **---** | **----** | **---** | **---** | **25** | **--** | **25** | **50** |

| Module | Content |
|---|---|
| 1 | To determine the infiltration rate of a particular plot of land using double ring infiltro-meter, and construct infiltration capacity curves. |
| 2 | To study the variation of meteorological parameters, such as air temperature, relative humidity, wind speed and wind direction using thermo hygrometer and anemometer. |
| 3 | To study the variation of hydrological parameters, water level and water temperature/ conductivity in a bore well using water level recorder. |
| 4 | To study free vortex and forced vortex phenomenon. |
| 5 | Performance characteristics of turbines. |

| Semester I | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRESBL101** | **Skill Based Lab-I** | **02** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| | **4** | | | **2** | | **02** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| | | | | | **50** | | **50** | **100** |

**Objectives**

- To make students aware about the difference between listening and hearing
- To enhance speaking and technical writing skills.
- To prepare students to face interviews, group discussions.

| Module | Description | Hrs |
|---|---|---|
| **I** | **Listening Skills:**<br>Barriers to listening, Kinds of Listening & Note making. | **02** |
| **II** | **Speaking Skills:**<br>Voice Modulation, Good Pronunciation, Speaking without fear, Extempore & Prepared<br>speaking, Body Language, Telephone Etiquette/ Mobile /Video conferences.<br>**Presentation Skills:**<br>Planning, preparing, Organizing, Delivery, Feedback. | **05** |
| **III** | **Reading Skills:**<br>SQ3R Reading Technique, Skimming and Scanning | **03** |
| **IV** | **Writing Skills:**<br>Building Vocabulary, Effective Sentences & paragraphs, Organizational Techniques<br>& patterns, Summarizing. | **10** |

| | | |
|---|---|---|
| | **Content writing:**<br>Social media post, blogs, LinkedIn Building Network Approach, articles and testimonials for websites<br>Media tools: like surfer SEO tools, keyword planner, copywritely, HubSpot topic generator, Grammarly, QuillBot | |
| **V** | **Types of Writing:**<br>Letters, memo, Reports/ Proposals/ Research Paper/ Conference Paper/ E-mails/Sharing<br>Documents On-line. | **04** |
| **VI** | **Interview:**<br>Pre-Interview Preparation, Interview Question Answer, Resume & Job Application,<br>Group Discussion, Telephone Interviews. | **03** |
| **IX** | **Seminar Presentation on the following Topics:**<br>(1) Time Management<br>(2) Motivation<br>(3) Negotiation & Conflict Management<br>(4) Stress Management<br>(5) IPR<br>(6) Transactional Analysis<br>(7) Leadership<br>(8) Emotional Intelligence (EQ/IQ)<br>(9) Assertiveness | **02** |

**Contribution to Outcomes**

**Students will be able to:**

- Differentiate between listening and hearing
- Develop speaking and technical writing skills
- Execute interviews, group discussions and presentation skill

**Reference Books**

1. Effective Technical Communication- M. Ashraf Rizvi (Tata McGraw Hill)
2. HBR Guide to Better Business Writing- Bryan A. Garner (Harvard Business Review Press)

# Semester II

| Semester II | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRC 201** | **Water Resources Economics Planning and Management** | **03** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| **03** | **--** | **--** | **03** | **--** | **--** | **03** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| **20** | **20** | **20** | **80** | **03 Hrs.** | **--** | **--** | **---** | **100** |

| Detailed Syllabus | | |
|---|---|---|
| **Sr. No** | **Content** | **Contact Hours** |
| 1 | **Planning and decision-making process**: Importance and necessity of planning, decision making process and various types and feasibility. | 6 |
| 2 | **Systems Approach to Water Resource Planning:** Water as economic commodity, Principles of economics. | 8 |
| 3 | **Economics of Planning**: Global scenario of water resources planning, Discounting techniques, Price theory, Resource allocation, project optimality conditions. Cost benefits studies, Role of benefit cost parameters in project selection. Economic feasibility tests. Decision making under uncertainty and risk. Cost benefit studies of single & multipurpose projects. Economic planning, capacity expansion. | `10 |
| 4 | **Multi objective planning:** Methods and analysis of multi objective planning, Stakeholders' participation, Preparation of feasibility report, interstate water disputes and case study. | 8 |
| 5 | **International development on water transfer**: Principles and challenges of IWRM. Importance and necessity, international water laws, trity etc. | 7 |

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is eithera class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part

(b) will be from any module other than module 3)

4. Only Four question need to be solved.

**Recommended Books:**


1. Kuiper, "Water Resources Project Economics" Buttersworth, London. 1971.
2. M. C. Chaturvedi, "Water Resources System Planning and Management"(1987), Tata McGraw Hill Co. New Delhi.
3. Helweg, O.J. "Water Resources Planning and Management" John Wiley and Sons Inc., USA.1985.

| Semester II | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRC 202** | **Design of Hydraulic Structures** | **03** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| **03** | **--** | **--** | **03** | **--** | **--** | **03** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| **20** | **20** | **20** | **80** | **03 Hrs.** | **--** | **--** | **---** | **100** |

| Detailed Syllabus |
|---|

| Sr. No | Content | Contact Hours |
|---|---|---|
| 1 | **Planning and investigations of reservoir and dam sites:** Choice and site selection of dams and reservoirs, Forces acting on solid gravity dam, modes of failures, stability analysis, elementary and practical profile of gravity dam, internal stresses and stress concentrations in gravity dam, joints, seals, keys in gravity dams, galleries, dam safety and hazard mitigation. | 6 |
| 2 | **Homogeneous and zoned embankment dams:** factors influencing design of embankment dams, criteria for safe design of embankment dam, steps in design of embankment dam, seepage analysis and its control through body and dam foundation, classification of rock fill dams and their design consideration, causes and failure of earthen dam. | 6 |
| 3 | **Arch and buttress Dams:** Types of arch dams and buttress dams, design and analysis of arch dams and buttress dams, and their suitability. | 8 |
| 4 | **Spillways**: Capacity of spillways, components and profile of different types spillways, Non-conventional type of spillways, selection and design of energy dissipaters | 6 |

| | | |
|---|---|---|
| 5 | **Diversion headworks:** Components of diversion head works and their functions, weirs barrages, Bligh's Creep theory, Lane's weighed theory. Design of weirs and barrages on permeable foundations. | 7 |
| 6 | **Canal structures:** Canal outlets, types of cross-drainages works, review of codes of practice, design of canal drops, operation and maintenance of canals. | 6 |

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is eithera class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part

(b) will be from any module other than module 3)

4. Only Four question need to be solved.

**Recommended Books:**


1. USBR, "Design of gravity dams", A Water Resources Technical Publication, Denver, Colorado, 1976.
2. USBR, "Design of small dams", a water resources technical publication, Oxford and IBH publishing co., New Delhi, 1974.
3. Creager W P, Justin J. D and Hinds J., "Engineering for dams" Nemchand and Brothers, Roorkee, 1995.
4. Irrigation Engineering and Hydraulic structures (Abridged Edition). Dr S.K. Ukarande, Ane's Student Edition., 2015.
5. Khatsuria, R M, "Hydraulics of spillways and energy dissipators", CRC Press, 2005.
6. Novak P, "Hydraulic Structures", Taylor and Francis Group publishers, 2001.
7. Grishin,M. M. Ed., "Hydraulic Structures", Vol. II, Mir Publishers, Moscow, 1982.

| Semester II | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRCPE2011** | **Program Elective 3: System Engineering and Its Application** | **03** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| **03** | **--** | **--** | **03** | **--** | **--** | **03** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| **20** | **20** | **20** | **80** | **03 Hrs.** | **--** | **--** | **---** | **100** |

| Detailed Syllabus | | |
|---|---|---|
| **Module** | **Content** | **Contact Hours** |
| 1 | **Economics and Concept of Optimization**<br>Principles of Engineering Economics -Equivalence of Kind, Equivalence of Time, Sunk Cost, Incremental Cost, Intangible Values, Predictive Uncertainty, Planning, Alternatives, Objectives of water resources development, Economic Analysis and<br>Discounting Techniques, Project Optimality Conditions | 09 |
| 2 | **Conventional Optimization techniques**<br>**Linear Programming:** Formulation of problem, graphical solutions, simplex method.<br>Solution by simplex method – Variations from standard form, the dual problem, Dual simplex method. Sensitivity analysis, Non-linear programming, one dimensional minimization methods – Newton – Raphson method, interval halving method, Fibonacci method, Big M method, Two-phase method, duality.<br>**Transportation problems:** BFS-Optimality test, maximization problems. Assignment Problems -minimization, maximization. | 12 |

| | | |
|---|---|---|
| | **Dynamic Programming (DP):** Introduction, solution of DP problems, characteristics of a DP problem, principle of optimality | |
| 3 | **Application of optimization techniques**<br>Applications of various optimization techniques to water resources engineering problems, applications Non-linear programming, water quality subsystem, optimum operation model for reservoir systems by incremental dynamic programming, sequence of multipurpose projects. | 09 |
| 4 | Case Studies-<br>Conjunctive use of ground water and surface water, hydropower optimization, crop yield optimization, multi-basin and multi-reservoir systems.<br>A Linear Programming Optimization of Water Resource Management with Virtual Water through Global Trade.<br>Nonlinear Reservoir Optimization Model with Stochastic Inflows.<br>Water recourses management by stochastic optimization.<br>Model for optimal allocation of water resources in saltwater intrusion area | 09 |

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is eithera class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part

(b) will be from any module other than module 3)

4. Only Four question need to be solved.

**Recommended Books:**

1. S. Vedula & P P Mujumdar Water Resources Systems, Tata McGraw-Hill Publishing Company Ltd.
2. A Ravindran, Don T Philips & James J Solberg, Operations Research – principles And Practice. John Wiley & Sons.
3. Daniel P. Loucks, Jerry R. Stedinger & D.A Haith-Water Resources systems Planning and Management. UNESCO Publishing.
4. Hall.W.A & Dracup.J.A- Water Resources Systems Engineering.
5. Mays L.W., and Tung YK, Hydro systems Engineering and Management. McGraw Hill Inc., New York, 19925.
6. Singiresu S Rao, Engineering Optimization Theory and Practice. New Age International (P) Ltd., Publishers, New Delhi.
7. Wagner, H. M., 'Principles of Operations Research', Prentice - Hall, 1975.
8. Arthur Mass et al, Design of Water Resources Systems, Macmillan,1970.
9. Alvin.S. Goodman, Principles of Water Resources Planning, Prentice Hall, Englewood Cliffs, New Jercey, 1984.

| Semester II | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRCPE3012** | **Program Elective 3: Water Power Engineering** | **03** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| **03** | **--** | **--** | **03** | **--** | **--** | **03** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| **20** | **20** | **20** | **80** | **03 Hrs.** | **--** | **--** | **---** | **100** |

| | Detailed Syllabus | |
|---|---|---|
| **Module** | **Content** | **Hours** |
| 1 | **Introduction:** Development of water power in India, estimation of hydropower potential, comparison of hydro, thermal and nuclear power. | 02 |
| 2 | **Analysis of Stream flow Demand:** Flow duration curve, firm power, secondary power, load and load duration curves, load factor, etc. | 05 |
| 3 | **Types of Hydropower Plants**: Classification of hydropower plants, run-of-river plants, valley dam plants, high head diversion plants, diversion canalplants, pumped storage plants, tidal power plants. | 04 |
| 4 | **Water Conveyance System:** Power canals, Alignment, Design of power canals, Flumes, Covered conduits and tunnels, Drainage and ventilation in tunnels. Penstocks: - Alignment, types of penstocks, economic diameter of penstocks, Anchor blocks. | 06 |
| 5 | **Dams:** Selection of site, preliminary investigations, final investigations, types of dams: rigid dams, gravity dams, arch and buttress dams, basic principles of design and details of construction. | 08 |
| 6 | **Embankment Dams/ Spillways:** Earthen dams, rock fill dams, design considerations. Types, spillway gates, design of stilling basins**.** | 06 |
| 7 | **Turbines and Power house details:** Types and utility, layout and parts of | 04 |

| | | |
|---|---|---|
| | the generation system. forebay, intakes, balancing reservoir, escape, surge shafts/ inclined shafts. General layout of power house and arrangement of hydropower units. underground power stations: general information | |
| 8 | **Transmission System:** General introduction, basic principles of design and construction. Financial implications of hydropower plants. | 04 |

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is eithera class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

**Recommended Books:**


1. Mosonyl, E., ―Water Power Development‖ Vol. I & II.
2. Brown, G. Etal., ―Hydro Electric Engineering Practice‖ Vol. I, II & III.
3. Dandekar M.M., ―Water Power Engineering‖ VIkas Pub. House Pvt.Ltd

| Semester II | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRCPE2013** | **Program Elective 3: Advanced Hydrologic Analysis and Design** | **03** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| **03** | **--** | **--** | **03** | **--** | **--** | **03** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| **20** | **20** | **20** | **80** | **03 Hrs.** | **--** | **--** | **---** | **100** |

| Detailed Syllabus | | |
|---|---|---|
| **Module** | **Content** | **Hours** |
| 1 | **Hydrologic and Hydraulic Models:** Hydrologic investigations, systems approach, and concept of a model. Classification of hydrological models, Chow-Kulandaiswamy model. Time-area methods, unit hydrograph, Instantaneous Unit Hydrograph. Synthetic Unit Hydrographs. Clark model, Nash model, Tank model. | 10 |
| 2 | **Hydrologic Simulation and Stream Flow Synthesis:** Classification of hydrologic simulation models. Single-event rainfall-runoff models. Continuous simulation models, groundwater flow simulation models. Streamflow synthesis, risk analysis – design storms and its synthesis. Design flows, urban storm drainage, design, airport drainage design, detention storage design. | 10 |
| 3 | **Random Processes:** Classification, stationary random process, components of time series, trend analysis, regression, multiple linear regression, diagnostic tools. | 09 |
| 4 | **Forecasting Models:** Box Jenkins' models, correlation, Auto correlation, Partial auto correlation – Yule Walker equations – AR (p) – MA (q) – ARMA (p,q) – ARIMA (p,d,q) models, model formulation, validation, and application. | 10 |

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is eithera class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part

(b) will be from any module other than module 3)

4. Only Four question need to be solved.

**Recommended Books:**


1. Singh, V. P.,"Hydrologic Systems", Prentice-Hall Englewood Cliffs, NJ 1989.
2. Jayarami Reddy P., "Stochastic Hydrology" Laxmi Publications, New Delhi 1995.
3. Viessman W Jr. "Introduction to Hydrology (5ed)" Pearson Education, Inc. 2003.
4. Haan C.T., "Statistical Methods in Hydrology" Iowa State Press 2002.

| Semester II | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRCPE2021** | **Program Elective 3: Integrated River Basin Management** | **03** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| **03** | **--** | **--** | **03** | **--** | **--** | **03** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| **20** | **20** | **20** | **80** | **03 Hrs.** | **--** | **--** | **---** | **100** |

| Detailed Syllabus | | |
|---|---|---|
| Module | **Content** | **Hours** |
| 1 | **Introduction:** Global and national scenario in general. Naturally functioning river basin river system. Concept of integration in the river basin setting. Conservation, management and development of water. Economic and social benefits, restoring freshwater ecosystem. | 9 |
| 2 | **River basin planning and management:** water quantity and quality and its protection; Land use; socio-economic condition; Integrated water resource planning management including water supply and demand management; urban and rural water development; decision support for river basin management; International river basin management including conflict and resolution and sustainable development. Maintenance of echo system, conventional approaches. | 10 |
| 3 | **Climate change and water resources sustainability:** Reasons, details of climate change, and sustainable development introduction to cost-benefit analysis economic evaluation of environmental goods environmental and social cost-benefit analysis. | 10 |
| 4 | **Long term vision:** Stake holders and initiates, integration of policies, decision and cost across, sectoral interest includes industry, agricultural, urban development, navigation, fisheries, fisheries management and conservations, strategic decision making at river basin scheme. | 10 |

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is eithera class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part

(b) will be from any module other than module 3)

4. Only Four question need to be solved.

**Recommended Books:**


1. Kemper, Karin; Blomquist, William; Dinar, "Integrated River Basin Management through Decentralization" Ariel (Eds.) 2007.
2. Saha S.K.,"River basin management theory and practice" Chichester:John Wiley,1981.
3. Falconer R. A. "River basin management" Cardiff University, United Kingdom and W. R. BLAIN, Wessex Institute of Technology, United Kingdom.

| Semester II | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRCPE2022** | **Program Elective 3: Soft Computing Techniques in Hydrology and Water Resources Engineering** | **03** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| **03** | **--** | **--** | **03** | **--** | **--** | **03** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| **20** | **20** | **20** | **80** | **03 Hrs.** | **--** | **--** | **---** | **100** |

| Detailed Syllabus | | |
|---|---|---|
| **Module** | **Content** | **Hours** |
| **1** | Introduction to Soft computing techniques- soft computing techniques, importance, types of soft computing techniques, advantages and limitations. | 04 |
| **2** | Introduction to Fuzzy logic: Fuzzy sets- Fuzzy set operations- Fuzzy Relations-Cardinality of Fuzzy Relations-Operations on Fuzzy Relations-Properties of Fuzzy relations- Membership Functions-Features of Membership functions- Fuzzification-Methods of Membership value Assignments- Fuzzy Rule Base-Defuzzification-Defuzzification methods-Fuzzy logic controller (Block Diagram) | 06 |
| **3** | Artificial Neural Networks: Basic Concepts-Neural network Architectures-Single layer feed forward network-Multilayer feed forward network-Recurrent Networks-Characteristics of Neural Networks-Learning methods. Perceptron networks-Back Propagation Networks-Radial base function network-Hopfield network- Kohonen Self organizing maps. | 09 |
| **4** | Fundamentals of genetic algorithms and Genetic Programming: Basic concepts- working principle – encoding different methods – fitness function, reproduction-different methods. Genetic modeling in heritance- Crossover mutation-convergence of genetic algorithm. Basic difference between genetic algorithm and genetic programming. | 10 |
| **5** | Introduction to Hybrid systems: Concept of hybrid system and its significance in general to water resources problems, Neural network, fuzzy logic and genetic algorithm hybrids – Neuro fuzzy hybrids- neuro genetic hybrids-Fuzzy genetic hybrids-Genetic algorithm based back propagation network- Fuzzy back propagation networks -fuzzy logic controlled genetic algorithms. | 10 |

**Assessment:**
**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is eithera class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part
(b) will be from any module other than module 3)
4. Only Four question need to be solved.

**Recommended Books:**

1. Rajasekharan, S. and Vijayalakshmi, G.A.Pai, ―Neural Network, Fuzzy Logic andGenetic Algorithms Synthesis and Applications‖, Prentice Hall India.

2. Sivanandam, S.N and Deepa, S.N. ―Principles of Soft Computing‖, Wiley India

3. Ross Timothy J, ―Fuzzy logic with Engineering Applications‖, McGraw Hill, NewYork.

4. Haykins S. ―Neural Networks a Comprehensive foundation‖, Pearson Education.

5. Goldberg, D.E. ―Genetic Algorithms in Search Optimization and Machine Learning‖,Pearson Education

Recent Literature

| Semester II | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRCPE2023** | **Program Elective 4: Advances in Irrigation Engineering** | **03** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| **03** | **--** | **--** | **03** | **--** | **--** | **03** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| **20** | **20** | **20** | **80** | **03 Hrs.** | **--** | **--** | **---** | **100** |

| Detailed Syllabus | | |
|---|---|---|
| **Sr. No** | **Content** | **Contact Hours** |
| 1 | **Irrigation Techniques:** Surface and Subsurface Irrigation, well Irrigation, Lift Irrigation, Sprinkler Irrigation and Drip Irrigation. Hydraulic design of Lift, Sprinkler & Drip Irrigation. Assessment of irrigation water, Audit of irrigation water. Preparation of irrigation schedules based on crop water requirement. Different types of irrigation water distribution. | 9 |
| 2 | **Reservoir operations:** Introduction to reservoir operations, types -Storage capacity of reservoir – Storage zones – Determining reservoir capacity for a given yield – Determining yield from a reservoir of a given capacity – Reservoir Losses – Reservoir sedimentation – Silt control.<br>Operation and maintenance of canal system, canal automation. River training, diversion and protection works. Reservoir operations. | 12 |
| 3 | **Rivers training:** types of rivers – its characteristics – Indian rivers and their classification – Straight reaches – Bends – Meanders –Cutoff – Control and training of rivers – Objectives of river training – Classification of rivertraining – Levees –Guide banks – Groynes – Artificial cutoffs – Pitched islands. | 9 |
| 4 | **Principles of irrigation water management:** Irrigation Efficiencies – Need for optimization – Management and productivity – Participatory approach – On farm development – Command area development. | 9 |

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is eithera

class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

**Recommended Books:**


1. Zimmerman, -Irrigation Engineering|| Wiely Toppan publication.
2. Sharma, S.K. -Principles and practice of Irrigation Engineering||. Chand and Company Ltd. New Delhi.
3. Michael, A.MIrrigation.,—Theory and practice‖ Vikas publishing house.
4. -Canal Automation||. CBIP Publication No. 238, New Delhi.
5. Asawa G.L., -Irrigation Engineering||, New Age International Publishers, 1996.
6. Asawa G.L., -Irrigation and Water Resources Engineering||, New Age International Publishers, 2007.

| Semester II | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRIE2021** | **Institute Level Elective: Project Management** | **03** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| **03** | **--** | **--** | **03** | **--** | **--** | **03** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| **20** | **20** | **20** | **80** | **03 Hrs.** | **--** | **--** | **---** | **100** |

**Objectives:**

- To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
- To appraise the students with the project management life cycle and make them

| Module | Detailed Contents | Hrs |
|---|---|---|
| **I** | **Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI). | **5** |
| **II** | **Initiating Projects:** How to get a project started, selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process,Project sponsor and creating charter; Project proposal. Effective project team, Stagesof team development & growth (forming, storming, norming & performing), team dynamics. | **6** |
| **III** | **Project Planning and Scheduling:** Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting,Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT,CPM, GANTT chart. Introduction to Project Management Information System (PMIS). | **8** |
| **IV** | **Planning Projects:** Crashing project time, Resource loading and leveling, Goldratt's critical | **6** |

| | | |
|---|---|---|
| | chain, | |
| | Project Stakeholders and Communication plan.<br>Risk Management in projects: Risk management planning, Risk identification and<br>risk register. Qualitative and quantitative risk assessment, Probability and impactmatrix. Risk response strategies for positive and negative risks | |
| **V** | **5.1 Executing Projects:**<br>Planning monitoring and controlling cycle. Information needs and reporting,engaging with all stakeholders of the projects.<br>Team management, communication and project meetings.<br>**5.2 Monitoring and Controlling Projects:**<br>Earned Value Management techniques for measuring value of work completed;Using milestones for measurement; change requests and scope creep. Project audit.<br>**5.3 Project Contracting**<br>Project procurement management, contracting and outsourcing, | **8** |
| **VI** | **6.1 Project Leadership and Ethics:**<br>Introduction to project leadership, ethics in<br>projects.Multicultural and virtual projects.<br>**6.2 Closing the Project:**<br>Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lesson learned analysis; acknowledging successes and failures; Project management templates and other<br>resources; Managing without authority; Areas of further study. | **6** |

**Outcomes**

Students will be able to:

- Apply selection criteria and select an appropriate project from different options.
- Write work break down structure for a project and develop a schedule based on it.
- Identify opportunities and threats to the project and decide an approach to deal with them strategically.
- Use Earned value technique and determine & predict status of the project.
- Capture lessons learned during project phases and document them for future reference

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is eithera class test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks

3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part

(b) will be from any module other than module 3)

4. Only Four question need to be solved.

**References:**


1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7thEd.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

| Semester II | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRIE2022** | **Institute Level Elective: Finance Management** | **03** |

**Teaching Scheme**

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

**Evaluation Scheme**

| Theory | | | | | Term work / Practical / Oral | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hrs. | -- | -- | -- | 100 |

**Objectives:**

- Overview of Indian financial system, instruments and market
- Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
- Knowledge about sources of finance, capital structure, dividend policy

| Module | Detailed Contents | Hrs |
|---|---|---|
| **I** | **Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System.<br>**Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills.<br>**Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market<br>**Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges | **06** |
| **II** | **Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio.<br>**Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting. | **06** |
| **III** | **Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision.<br>**Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio | **09** |

| | | |
|---|---|---|
| | Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis. | |
| **IV** | **Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR)<br>**Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities. | **10** |
| **V** | **Sources of Finance:** Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short-Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance.<br>**Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure | **05** |
| **VI** | **Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach | 03 |

**Outcomes**

Students will be able to…

- Understand Indian finance system and corporate finance
- Take investment, finance as well as dividend decisions

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is either aclass test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

**References:**


1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.

| Semester II | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRIE2023** | **Institute level Elective: Entrepreneurship Development and Management** | **03** |

**Teaching Scheme**

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

**Evaluation Scheme**

| Theory | | | | | Term work / Practical / Oral | | | **Total Marks** |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hrs. | -- | -- | -- | 100 |

**Objectives:**

- To acquaint with entrepreneurship and management of business
- Understand Indian environment for entrepreneurship
- Idea of EDP, MSME

| Module | Detailed Contents | Hrs |
|---|---|---|
| **I** | **Overview of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership<br>Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship | **04** |
| **II** | **Business Plans and Importance of Capital To Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur<br>**Entrepreneurship And Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations | **09** |
| **III** | Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises | **05** |
| **IV** | **Indian Environment for Entrepreneurship:** key regulations and legal aspects, MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organizations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit | **08** |

| | | |
|---|---|---|
| | Guarantee Fund, PMEGP, discussions, group exercises etc | |
| **V** | **Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing | **08** |
| **VI** | **Achieving Success in The Small Business:** Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business | **05** |

**Outcomes:**

Students will be able to…

- Understand the concept of business plan and ownerships
- Interpret key regulations and legal aspects of entrepreneurship in India
- Understand government policies for entrepreneurs

**Assessment**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is either aclass test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

**References:**


1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

| Semester II | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRIE2024** | **Institute level Elective: Human Resource Management** | **03** |

**Teaching Scheme**

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

**Evaluation Scheme**

| Theory | | | | | Term work / Practical / Oral | | | **Total Marks** |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hrs. | -- | -- | -- | 100 |

**Objectives:**

- To introduce the students with basic concepts, techniques and practices of the human resourcemanagement.
- To provide opportunity of learning Human resource management (HRM) processes, related withthe functions, and challenges in the emerging perspective of today's organizations.
- To familiarize the students about the latest developments, trends & different aspects of HRM.
- To acquaint the student with the importance of inter-personal & inter-group behavioral skills inan organizational setting required for future stable engineers, leaders and managers.

| Module | Detailed Contents | Hrs |
|---|---|---|
| **I** | **Introduction to HR**<br>Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions.<br>Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues. | 5 |
| **II** | **Organizational Behavior (OB)**<br>Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues<br>Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness<br>Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior.<br>Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor);<br>Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team.<br>Case study | 7 |
| **III** | **Organizational Structure &Design**<br>Structure, size, technology, Environment of organization; Organizational Roles & | 6 |

| | | |
|---|---|---|
| | conflicts: Concept of roles; role dynamics; role conflicts and stress.<br>Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership.<br>Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies. | |
| **IV** | **Human resource Planning**<br>Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale.<br>Performance Appraisal Systems: Traditional & modern methods, Performance Counseling, Career Planning.<br>Training & Development: Identification of Training Needs, Training Methods | 5 |
| **V** | **Emerging Trends in HR**<br>Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development, managing processes & transformation in HR. Organizational Change, Culture, Environment<br>Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation. | 6 |
| **VI** | **HR & MIS**<br>Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries<br>**Strategic HRM**<br>Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals<br>**Labor Laws & Industrial Relations**<br>Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act | 10 |

**Contribution to Outcomes:**

Students will be able to:

- Understand the concepts, aspects, techniques and practices of the human resource management.
- Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
- Gain knowledge about the latest developments and trends in HRM.
- Apply the knowledge of behavioral skills learnt and integrate it with in inter personal and

**Assessment:**
**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is either aclass test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional tonumber of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

**References:**


1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

| Semester II | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRIE2025** | **Institute level Elective: Professional Ethics and CSR** | **03** |

**Teaching Scheme**

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

**Evaluation Scheme**

| Theory | | | | | Term work / Practical / Oral | | | **Total Marks** |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hrs. | -- | -- | -- | 100 |

**Objectives:**

- To understand professional ethics in business
- To recognized corporate social responsibility

| Module | Detailed Contents | Hrs |
|---|---|---|
| **01** | **Professional Ethics and Business:** The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business | 04 |
| **02** | **Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy<br>**Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources | 08 |
| **03** | **Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy<br>**Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs. | 06 |
| **04** | **Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection.<br>Trajectory of Corporate Social Responsibility in India | 05 |
| **05** | **Corporate Social Responsibility:** Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) | 08 |
| **06** | **Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013. | 08 |

**Contribution to outcomes**

Students will be able to…

- Understand rights and duties of business
- Distinguish different aspects of corporate social responsibility
- Demonstrate professional ethics
- Understand legal aspects of corporate social responsibility

**Assessment:**
**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is either aclass test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional tonumber of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

**References:**


1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane,Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher:Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by BidyutChakrabarty, Routledge, New Delhi.

| Semester II | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRIE2026** | **Institute level Elective: Research Methodology** | **03** |

**Teaching Scheme**

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

**Evaluation Scheme**

| Theory | | | | | Term work / Practical / Oral | | | **Total Marks** |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hrs. | -- | -- | -- | 100 |

**Objectives:**

- To understand Research and Research Process
- To acquaint students with identifying problems for research and develop research strategies
- To familiarize students with the techniques of data collection, analysis of data and interpretation

| Module | Detailed Contents | Hrs |
|---|---|---|
| **01** | **Introduction and Basic Research Concepts**<br>**1.1** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology<br>**1.2** Need of Research in Business and Social Sciences<br>**1.3** Objectives of Research<br>**1.4 Issues** and Problems in Research<br>**1.5** Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical | **09** |
| **02** | **Types of Research**<br>**2.1.** Basic Research<br>**2.2.** Applied Research<br>**2.3.** Descriptive Research<br>**2.4.** Analytical Research<br>**2.5.** Empirical Research<br>**2.6** Qualitative and Quantitative Approaches | **07** |
| **03** | **Research Design and Sample Design**<br>**3.1** Research Design – Meaning, Types and Significance<br>**3.2** Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors | **07** |
| **04** | **Research Methodology**<br>**4.1** Meaning of Research Methodology<br>**4.2**. Stages in Scientific Research Process: | **08** |

| | | |
|---|---|---|
| | **a.** Identification and Selection of Research Problem<br>**b.** Formulation of Research Problem<br>**c.** Review of Literature<br>**d.** Formulation of Hypothesis<br>**e.** Formulation of research Design<br>**f.** Sample Design<br>**g.** Data Collection<br>**h.** Data Analysis<br>**i.** Hypothesis testing and Interpretation of Data<br>**j.** Preparation of Research Report | |
| **05** | **Formulating Research Problem**<br>**5.1** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis | **04** |
| **06** | **Outcome of Research**<br>**6.1** Preparation of the report on conclusion reached<br>**6.2** Validity Testing & Ethical Issues<br>**6.3** Suggestions and Recommendation | **04** |

**Outcomes**

Students will be able to:

- Prepare a preliminary research design for projects in their subject matter areas
- Accurately collect, analyze and report data
- Present complex data or situations clearly
- Review and analyze research findings

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignment on complete syllabus or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.
5.

**References:**


1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, ($2^{nd}$ed), Singapore, Pearson Education

| Semester II | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRIE2027** | **Institute level Elective: IPR & Patenting** | **03** |

**Teaching Scheme**

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

**Evaluation Scheme**

| Theory | | | | | Term work / Practical / Oral | | | **Total Marks** |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hrs. | -- | -- | -- | 100 |

**Objectives:**

- To understand intellectual property rights protection system
- To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
- To get acquaintance with Patent search and patent filing procedure and applications

| Module | Detailed Contents | Hr |
|---|---|---|
| **01** | **Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc.<br>**Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development | 05 |
| **02** | **Enforcement of Intellectual Property Rights:** Introduction, Magnitude ofproblem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) activein IPR enforcement<br>**Indian Scenario of IPR:** Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc. | 07 |
| **03** | **Emerging Issues in IPR:** Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc. | 05 |
| **04** | **Basics of Patents:** Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification | 07 |

| | | |
|---|---|---|
| | Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent | |
| **05** | **Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.) | 08 |
| **06** | **Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication etc, Time frame and cost, Patent Licensing, Patent Infringement<br>**Patent databases:** Important websites, Searching international databases | 07 |

**Outcomes:**

Students will be able to…

- understand Intellectual Property assets
- assist individuals and organizations in capacity building
- work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is either aclass test or at least 6 assignment on complete syllabus or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

**Reference Books:**


1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian,2012,Intellectual Property Rights, 1st Edition,Excel Books

9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi**,** IPR: Drafting,Interpretation of Patent Specifications and Claims**,** New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers,IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

| Semester II | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRIE2028** | **Institute level Elective: Digital Business Management** | **03** |

**Teaching Scheme**

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

**Evaluation Scheme**

| Theory | | | | | Term work / Practical / Oral | | | **Total Marks** |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hrs. | -- | -- | -- | 100 |

**Objectives:**

- To familiarize with digital business concept
- To acquaint with E-commerce
- To give insights into E-business and its strategies

| Module | Detailed content | Hrs |
|---|---|---|
| 1 | **Introduction to Digital Business-**<br>Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts<br>Difference between physical economy and digital economy,<br>**Drivers of digital business**- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things (digitally intelligent machines/services)<br>Opportunities and Challenges in Digital Business, | 09 |
| 2 | **Overview of E-Commerce**<br>**E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement<br>B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals<br>Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing<br>EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC | 06 |
| 3 | **Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system<br>**Application Development:** Building Digital business Applications and Infrastructure | 06 |
| 4 | **Managing E-Business**-Managing Knowledge, Management skills for e-business, Managing Risks in e –business<br>Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital | 06 |

| | | |
|---|---|---|
| | Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications | |
| 5 | **E-Business Strategy**-E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation) | 04 |
| 6 | **Materializing e-business: From Idea to Realization**-Business plan preparation **Case Studies and presentations** | 08 |

**Outcomes:**

Students will be able to:

- Identify drivers of digital business
- Illustrate various approaches and techniques for E-business and management
- Prepare E-business plan

**Assessment:**
**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignment on complete syllabus or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

**References:**


1. A textbook on E-commerce**,** Er Arunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, VinocenzoMorabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective -DOI:10.1787/9789264221796-enOECD Publishing

| Semester II | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRIE2029** | **Institute level Elective: Environmental Management** | **03** |

**Teaching Scheme**

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | -- | -- | 03 | -- | -- | 03 |

**Evaluation Scheme**

| Theory | | | | | Term work / Practical / Oral | | | **Total Marks** |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test 1 | Test 2 | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hrs. | -- | -- | -- | 100 |

**Objectives:**

- Understand and identify environmental issues relevant to India and global concerns
- Learn concepts of ecology
- Familiarize environment related legislations

| Module | Detailed Contents | Hrs |
|---|---|---|
| **I** | Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities.<br>Environmental issues relevant to India, Sustainable Development, The Energy scenario. | 10 |
| **II** | Global Environmental concerns: Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc. | 06 |
| **III** | Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc. | 05 |
| **IV** | Scope of Environment Management, Role & functions of Government as a planning and regulating agency.<br>Environment Quality Management and Corporate Environmental Responsibility | 10 |
| **V** | Total Quality Environmental Management, ISO-14000, EMS certification. | 05 |
| **VI** | General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc. | 03 |

**Contribution to Outcomes**

Students will be able to…

- Understand the concept of environmental management
- Understand ecosystem and interdependence, food chain etc.
- Understand and interpret environment related legislations

**Assessment:**

**Internal:**

Assessment consists of two tests out of which; one should be compulsory class test and the other is either aclass test or assignment on live problems or course project.

**End Semester Theory Examination:**

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional tonumber of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

**References:**


1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London,1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell,Edward Elgar Publishing
3. Environmental Management,T V Ramachandra and Vijay Kulkarni, TERI Press
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use,Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, MaclillanIndia, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

| Semester II | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WREL201** | **Program Lab-II** | **02** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| | **2** | | | **1** | | **02** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| **---** | **---** | **---** | **---** | **---** | **25** | **---** | **25** | **50** |

| Sr. No | Content |
|---|---|
| 1 | Rainfall data collection by natural siphon recording type rain gauge and determination of mass curve & hyetograph from obtained data and its analysis. |
| 2 | Determination of $\phi$ index by double ring type infiltrometer and its significance. |
| 3 | Measurement of permeability of soil and analysis |
| 4 | Determination of rate of evaporation |
| 5 | Measurement of Water quality parameters |
| 6 | Study and analysis of pumping test well (expected to perform test on well) |
| 7 | Design of rain water harvesting system |

| Semester II | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **WRESBL201** | **Skill Based Lab-II** | **02** |

| Teaching Scheme | | | | | | |
|---|---|---|---|---|---|---|
| **Contact Hours** | | | **Credits Assigned** | | | |
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| **---** | **4** | **--** | **---** | **2** | **--** | **02** |

| Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Term Work/ Practical/Oral** | | | **Total** |
| **Internal Assessment** | | | **End Sem Exam** | **Duration of End Sem Exam** | **TW** | **PR** | **OR** | |
| **Test 1** | **Test 2** | **Average** | | | | | | |
| **---** | **---** | **--** | **---** | **---** | **50** | **---** | **50** | **100** |

Candidates are expected to perform minimum six assignments, and submit reports as bonafide documents to supervisor/course instructor for each assignment. The assignment may be in the form of modeling/ simulation/ programming/ experimental investigation/ fieldwork as detailed below:

| Sr. No | Content |
|---|---|
| 1 | Assignment based on dam break problem or model study on a hydraulic structure or open channel and detailed analysis. |
| 2 | Design any type of innovative irrigation scheme |
| 3 | Employ Remote sensing and any GIS software for water resource planning of a region |
| 4 | Visit to a hydraulic structures & preparation of visit report. |
| 5 | Assignments based on stability analysis of gravity/earth/rockfill dams. |
| 6 | Development of computer program to solve pipe network problem |
| 7 | Application of spreadsheet, XLSTAT, SPSS and similar softwares used for prediction/simulation of runoff/floods for downstream regions during monsoon and non-monsoon seasons |
| 8 | Summarizing two articles related to water resources engineering from reputed technical journals |

**Contribution to Outcomes**

Students will be able to:

- Write effective project reports highlighting the pros & cons of the technologies envisaged for the project
- Apply spreadsheet (excel or other) tools to simplify complex civil engineering problems
- Employ Remote sensing and any GIS software for water resource planning of a region
- Design irrigation systems
- Use softwares to address issues in water resources management
- Summarize technical articles and write technical papers in reputed journals