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# **PhD (Mathematics)**

**Ordinances, Scheme and Syllabus**

**(U/S 2(f) and 12B of the UGC Act1956, NAAC Accredited)**

**DESH BHAGAT UNIVERSITY, MANDI GOBINDGARH**

**Faculty of Engineering and Applied Sciences**

**Department of Applied Sciences**

**Program: PhD (Mathematics)**

### Short title, Application and Commencement:

These Regulations may be called University Grants Commission (Minimum Standards and Procedure for Award of M.Phil /Ph.D. Degrees) Regulations, 2016.

They shall apply to every University established or incorporated by or under a Central Act, a Provincial Act, or a State Act, every affiliated college, and every Institution Deemed to be a University under Section 3 of UGC Act, 1956.

They shall come into force from the date of their publication in the Gazette of India.

### Eligibility criteria for admission to the PhD programme:

Subject to the conditions stipulated in these Regulations, the following persons are eligible to seek admission to the Ph.D programme:

Master’s Degree holders satisfying the criteria stipulated under Clause 2 above. Candidates who have cleared the M.Phil course work with at least 55% marks in aggregate or its equivalent grade 'B' in the UGC 7-point scale (or an equivalent grade in a point scale wherever grading system is followed) and successfully completing the M.Phil. Degree shall be eligible to proceed to do research work leading to the Ph. D. Degree in the same Institution in an integrated programme. A relaxation of 5% of marks, from 55% to 50%, or an equivalent relaxation of grade, may be allowed for those belonging to SC/ST/OBC (non-creamy layer)/differently-abled and other categories of candidates as per the decision of the Commission from time to time.

A person whose M.Phil. Dissertation has been evaluated and the viva voce is pending may be admitted to the Ph.D programme of the same Institution;

Candidates possessing a Degree considered equivalent to M.Phil. Degree of an Indian Institution, from a Foreign Educational Institution accredited by an Assessment and Accreditation Agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country for the purpose of assessing, accrediting or assuring quality and standards of educational institutions, shall be eligible for admission to Ph.D programme.

### Duration of the Programme:

M.Phil. programme shall be for a minimum duration of two (2) consecutive semesters / one year and a maximum of four (4) consecutive semesters/ two years.

Ph.D. programme shall be for a minimum duration of three years,including course work and a maximum of six years.

Extension beyond the above limits will be governed by the relevant clauses as stipulated in the Statute/Ordinance of the individual Institution concerned.

The women candidates and Persons with Disability (more than 40% disability) may be allowed a relaxation of one year for M.Phil and two years for Ph.D. in the maximum duration.In addition, the women candidates may be provided Maternity Leave/Child Care Leave once in the entire duration of M.Phil /Ph.D.forupto240days.

### Procedure for admission:

All Universities and Institutions Deemed to be Universities shall admit M.Phil /Ph.D. students through an Entrance Test conducted at the level of Individual University/Institution Deemed to be a University. The University/Institution Deemed to be a University may decide separate terms and conditions for Ph.D. Entrance Test for those students who qualify UGC-NET (including JRF)/UGC-CSIR NET (including JRF)/SLET/GATE/teacher fellowship holder or have passed M.Phil programme. Similar approach may be adopted in respect of Entrance Test for M.Phil programme.

Higher Educational Institutions (HEIs) referred to in sub-clause 1.2 above and Colleges under them which are allowed to conduct M.Phil.and /orPh.D programmes shall:

Decide on an annual basis through their academic bodies a predetermined and manageable number of M.Phil .and/or Ph.D.scholars to be admitted depending on the number of available Research Supervisors and other academic and physical facilities available, keeping in mind the norms regarding the scholar- teacher ratio(as indicated in Para 6.5),laboratory ,library and such other facilities; notify well in advance in the institutional website and through advertisement in at least two (2) national newspapers, of which at least one (1) shall be in the regional language, the number of seats for admission, subject/discipline-wise distribution of available seats, criteria for admission, procedure for admission, examination centre(s)where entrance test(s) shall be conducted and all other relevant information for the benefit of the candidates; adhere to the National/State-level reservation policy, as applicable. The admission shall be based on the criteria notified by the Institution, keeping in view the guidelines/norms in this regard issued by the UGC and other statutory bodies concerned, and taking into account the reservation policy of the Central /State Government from time to time. HEIs as mentioned in Clause1.2shalladmitcandidatesbyatwostageprocess through:

An Entrance Test shall be qualifying with qualifying marks as 50%. The syllabus of the Entrance Test shall consist of 50% of research methodology and 50% shall b e subject specific. The Entrance Test shall be conducted at the Centre(s) notified in Advance (changes of Centres, if any, also to be notified well in advance) at the level of the individual HEI as mentioned in clause 1.2; and An interview/*viva-voce* to be organized by the HEI as mentioned in clause 1.2 when the candidates are required to discuss their research interest/area through a presentation before a duly constituted Department Research Committee. The interview/viva voce shall also consider the following aspects, viz. whether:

The candidate possesses the competence for the proposed research;

The research work can be suitably undertaken at the Institution/College;

The proposed area of research can contribute to new/additional knowledge.

The University shall maintain the list of all the M.Phil. / Ph.D. registered students on its website on year-wise basis. The list shall include the name of the registered candidate, topic of his/her research, name of his/her supervisor/co-supervisor, date of enrolment/registration.

**Allocation of Research Supervisor:**

Eligibility criteria to be a Research Supervisor, Co- Supervisor, Number of M.Phil /Ph.D scholars permissible per Supervisor, etc.

Any regular Professor of the University/Institution Deemed to be a University/College with at least five research publications in refereed journals and any regular Associate/Assistant Professor of the university /institution deemed to be a university/college with a Ph.D degree and at least two research publications in refereed journals may be recognized as Research Supervisor.

Provided that in areas/disciplines where there is no or only a limited number of refereed journals, the Institution may relax the above condition for recognition of a person as Research Supervisor with reasons recorded in writing.

Only a fulltime regular teacher of the concerned University/Institution Deemed to be a University/College can act as a supervisor. The external supervisors are not allowed. However, Co-Supervisor can be allowed in inter-disciplinary areas from other departments of the same institute or from mother related institutions with the approval of the Research Advisory Committee.

The allocation of Research Supervisor for a selected research scholar shall be decided by the Department concerned depending on the number of scholars per Research Supervisor, the available specialization among the Supervisors and research interests of the scholars as indicated by them at the time of interview/*viva voce*

In case of topics which are of inter-disciplinary nature where the Department concerned feels that the expertise in the Department has to be supplemented from outside, the Department may appoint a Research Supervisor from the Department itself, who shall be known as the Research Supervisor, and a Co-Supervisor from outside the Department/ Faculty/College/Institution on such terms and conditions as maybe specified and agreed upon by the consenting Institutions/Colleges.

A Research Supervisor/Co-supervisor who is a Professor, at any given point of time, cannot guide more than three (3) M.Phil. and Eight (8) Ph.D. scholars. An Associate Professor as Research Supervisor can guide up to a maximum of two (2) M.Phil. and six (6) Ph.D. scholars and an Assistant Professor as Research Supervisor can guide upto a maximum of one (1)M.Phil. and four(4) Ph.D.scholars.

In case of relocation of an M.Phil /Ph.D. woman scholar due to marriage or otherwise, the research data shall be allowed to be transferred to the University to which the scholar intends to relocate provided all the other conditions in these regulations are followed in letter and spirit and the research work does not pertain to the project secured by the parent institution/ supervisor from any funding agency.The scholar will however give due credit to the parent guide and the institution for the part of research already done.

**Course Work:** Credit Requirements, number, duration ,syllabus, minimum standards for completion, etc.

The credit assigned to the M.Phil. or Ph.D. course work shall be a minimum of 08 creditsand amaximum of 16credits.

The course work shall be treated as prerequisite for M.Phil./Ph.D. preparation. A minimum of four credits shall be assigned to one or more courses on Research Methodology which could cover areas such as quantitative methods, computer applications , research ethics and review of published research in the relevant field, training, field work, etc. Other courses shall be advanced level courses preparing the students for M.Phil./Ph.D .degree.

All courses prescribed for M.Phil. and Ph.D. course work shall be in conformity with the credit hour instructional requirement and shall specify content ,instructional and assessment methods. They shall be duly approved by the authorized academic bodies.

The Department where the scholar pursues his/her research shall prescribe the course(s) to him/her based on the recommendations of the Research Advisory Committee, as stipulated under sub-Clause8.1below, of the research scholar.

All candidates admitted to the M.Phil. and Ph.D. programmes shall be required to complete the coursework prescribed by the Department during the initial one or two semesters.

Candidates already holding M. Phil. degree and admitted to the Ph.D. programme, or those who have already completed the course work in M.Phil. and have been permitted to proceed to the Ph.D. in integrated course, may be exempted by the Department from the Ph.D course work. All other candidates admitted to the Ph.D. programme shall be required to complete the Ph.D. course work prescribed by the Department.

Grades in the course work, including research methodology courses shall be finalized after a combined assessment by the Research Advisory Committee and the Department and the final grades shall be communicated to the Institution/College.

A M.Phil./Ph.D. scholar has to obtain a minimum of 55% of marks or its equivalent grade in the UGC7-point scale (or an equivalent grade/CGPA in a point scale wherever grading system is followed) in the coursework in order to be eligible to continue in the programme and submit the dissertation/thesis.

### Research Advisory Committee and its functions:

There shall be a Research Advisory Committee, or an equivalent body for similar purpose as defined in the Statutes/Ordinances of the Institution concerned, for each M.Phil. and Ph.D. scholar. The Research Supervisor of the scholar shall be the Convener of this Committee. This Committee shall have the following responsibilities:

To review the research proposal and finalize the topic of research;

To guide the research scholar to develop the study design and methodology of research and identify the course(s) that he/she may have to do.

To periodically review and assist in the progress of the research work of the research scholar.

A research scholar shall appear before the Research Advisory Committee once in six months to make a presentation of the progress of his/her work for evaluation and further guidance. The six monthly progress reports shall be submitted by the Research Advisory Committee to the Institution/College with a copy to the research scholar.

In case the progress of the research scholar is unsatisfactory, the Research Advisory Committee shall record the reasons for the same and suggest corrective measures. If the research scholar fails to implement these corrective measures ,the Research Advisory Committee may recommend to the Institution/College with specific reasons for cancellation of the registration of the research scholar.

### Evaluation and Assessment Methods, minimum standards/credits for award of the degree,etc.:

The overall minimum credit requirement, including credit for the course work, for the award of M.Phil. degree shall not be less than 24 credits.

Upon satisfactory completion of coursework ,and obtaining the marks /grade prescribed in sub-clauses 7.8 above,as the case maybe ,the M.Phil./Ph.D .scholar shall be required to undertake research work And produce a draft dissertation/thesis within a reasonable time ,asstipulated by the Institution concerned based on these Regulations.

Prior to the submission of the dissertation/thesis,the scholar shall make a presentation in the Department before the Research Advisory Committee of the Institution concerned which shall also be open to all faculty members and other research scholars. The feedback and comments obtained from them may be suitably incorporated into the draft dissertation/thesis in consultation with the Research Advisory Committee.

M.Phil scholars shall present at least one (1) research paper in a conference/seminar and Ph.D. scholars must publish at least one (1) research paper in refereed journal and make two paper presentations in conferences/seminars before the submission of the dissertation/thesis for adjudication, and produce evidence for the same in the form of presentation certificates and/or reprints. The Academic Council (or its equivalent body) of the Institution shall evolve a mechanism using well developed software and gadgets to detect plagiarism and other forms of academic dishonesty. While submitting for evaluation, the dissertation/thesis shall have an undertaking from the research scholar and a certificate from the Research Supervisor attesting to the originality of the work, vouching that there is no plagiarism and that the work has not been submitted for the award of any other degree/diploma of the same Institution where the work was carried out, or to any other Institution.

The M.Phil dissertation submitted by a research scholar shall be evaluated by his/her Research Supervisor and at least one external examiner who is not in the employment of the Institution/ College. The *viva-voce* examination, based among other things, on the critiques given in the evaluation report, shall be conducted by both of them together, and shall be open to be attended by Members of the Research Advisory Committee, all faculty members of the Department, other research scholars and other interested experts/ researchers.

The Ph.D. thesis submitted by a research scholar shall be evaluated by his/her Research Supervisor and at least two external examiners, who are not in employment of the Institution/College, of whom one examiner may be from outside the country. The *viva- voce* examination, based among other things, on the critiques given in the evaluation report, shall be conducted by the Research Supervisor and at least one of the two external examiners, and shall be open to be attended by Members of the Research Advisory Committee, all faculty members of the Department other research scholars and other interested experts/researchers.

The public *viva-voce* of the research scholar to defend the dissertation/thesis shall be conducted only if the evaluation report(s) of the external examiner(s) on the dissertation/thesis is/are satisfactory and include a specific recommendation for conducting the *viva-voce* examination. If the evaluation report of the external examiner in case of M.Phil. dissertation, or one of the evaluation reports of the external examiner in case of Ph.D. thesis, is unsatisfactory and does not recommend *viva-voce*, the Institution shall send the dissertation/ thesis to another external examiner out of the approved panel of examiners and the *viva-voce* examination shall be held only if there report of the latest examiner is satisfactory. If the report of the latest examiner is also unsatisfactory, the dissertation/ thesis shall be rejected and the research scholar shall be declared ineligible for the award of the degree.

The Institutions shall develop appropriate methods so as to complete the entire process of evaluation of M.Phil. dissertation/ Ph.D. thesis within a period of six months from the date of submission of the dissertation/thesis.

### Academic, administrative and infrastructure requirement to be fulfilled by Colleges for getting recognition for offering M.Phil./Ph.D programmes:

Colleges may be considered eligible to offer M.Phil./Ph .D programmes only if they satisfy the availability of eligible Research Supervisors, required infrastructure and supporting administrative and research promotion facilities as per these Regulations.

Postgraduate Departments of Colleges, Research laboratories of Government of India /State Government with at least two Ph.D. qualified teachers/scientists/other academic staff in the Department concerned along with required infrastructure, supporting administrative and research promotion facilities as per these Regulations, stipulated under sub-clause 10.3, shall be considered eligible to offer M.Phil./Ph.D.programmes. Colleges should additionally have the necessary recognition by the Institution under which they operate to offer M.Phil/Ph.D.programe.

Colleges with adequate facilities for research as mentioned below alone shall offer M.Phil./ Ph.D programmes:

In case of science and technology disciplines exclusive research laboratories with sophisticated equipment as specified by the Institution concerned with provision for adequate space per research scholar along with computer facilities and essential software, and uninterrupted power and water supply;

Ear marked library resources including latest books ,Indian and International journals, e-journals, extended working hours for all disciplines ,adequate space for research scholars in the Department/library for reading, writing and storing study and research materials; Colleges may also access the required facilities of the neighbouring Institutions/Colleges, or of those Institutions/Colleges/R&D laboratories/Organizations which have the required facilities.

Treatment of Ph.D/M.Phil through Distance Mode/Part-time:

Not withstanding anything contained in these Regulations or any other Rule or Regulation, for the time being in force, no University; Institution, Deemed to be a University and College shall conduct M.Phil.and Ph.D.Programmes through distance education mode.

Part-time Ph.D will be allowed provided all the conditions mentioned in the extant Ph.D Regulations are met.

### Award of M.Phil./Ph.D.degrees prior to Notification of these Regulations, or degrees awarded by foreign Universities:

Award of degrees to candidates registered for the M.Phil./Ph.D. programme on or after July 11, 2009 till the date of Notification of these Regulations shall be governed by the provisions of the UGC (Minimum Standards and procedure for Awards of M.Phil/Ph.D Degree ) Regulation,2009.

If the M.Phil./Ph.D.degree is awarded by a Foreign University ,the Indian Institution considering such a degree shall refer the issue to a Standing Committee constituted by the concerned institution for the purpose of determining the equivalence of the degree awarded by the foreign University.

### Depository with INFLIBNET:

Following the successful completion of the evaluation process and before the announcement of the award of the M.Phil./Ph.D. degree(s), the Institution concerned shall submit an electronic copy of the M.Phil. dissertation /Ph. D. thesis to the INFLIBNET, for hosting the same so as to make it accessible to all Institutions/Colleges.

Prior to the actual award of the degree,the degree-awarding Institution shall issue a provisional Certificate to the effect that the Degree has been awarded in accordance with the provisions of these UGC Regulations,2016.

**(U/S 2(f) and 12B of the UGC Act1956, NAAC Accredited)**

**DESH BHAGAT UNIVERSITY, MANDI GOBINDGARH**

**Faculty of Engineering and Applied Sciences**

**Department of Applied Sciences**

**Vision of the Department:**

The department of Applied Sciences is committed to inculcate expertise in the students in the field of basic sciences, technology and personality development so that they can make the world a better place.

**Mission of the Department:**

**M1:** Prepare the students’ basics strongly to make a mark at global perspective.

**M2:** Culminate extraordinary analytical, logical and ethical skills to make them industry ready.

**M3:** Develop a good citizen and a good human being through all round development.

**Program Educational Objectives (PEOs):**

**PEO1 Fundamental Knowledge:** to attain skills in the fundamental concepts of basic sciences necessary for success in industry or in engineering practices as well as advanced study.

**PEO2 Specialization:** prepare to pursue career choices in all branches of engineering or related interdisciplinary fields that will benefit from a strong background in applied sciences and engineering.

**PE3 Design Skills:** to imbibe with problem solving skills, laboratory skills, and design skills for technical careers in solving critical problems.

**Program Outcomes (POs):**

**PO1 Scientific Knowledge**: To employ critical thinking and the scientific method to design not only with respect to science subjects but also in all aspects related to life.

**PO2 Understanding and critical thinking:** To demonstrate an understanding of major concepts in all disciplines of Science.

**PO3 Problem analysis:** To analyze the scientific data critically and systematically and the ability to draw the objective conclusions.

**PO4 Design/development of solutions**: To foster observation skills and drawing logical conclusions from the scientific experiments.

**PO5 Conduct investigations of complex problems**: To develop scientific temper to propose novel ideas in explaining facts and figures or providing new solution to the problems.

**PO6 Scientist and Society**: To cultivate rational outlook and analyze the results of experiments and get an awareness of the impact of Science on the environment, society, and other cultures outside the scientific commUnity.

**PO7 Environment and sustainability:** To imbibe with new ideas for the sustainable developments.

**PO8 Ethics and Responsibility:** To nurture ethical, social and moral values in personal and social life paving a path to highly cultured and civilized personality.

**PO9 Management and projects**: Enhancing To acquire the analytical skills in handling scientific instruments, planning and performing in laboratory experiments.

**PO10 Individual and Team Work**: To apply knowledge and experience to foster personal growth and appreciate the diverse social world in which we live.

**PO11 Modern tool usage**: To provide technology-oriented skills, tools and ability to develop creative solutions and engage in continuing professional development.

**PO12 Life-long learning:** To attain the knowledge of subjects in other faculties such as humanities, performing arts, social sciences etc. can have greatly and effectively influence which inspires in evolving new scientific theories and inventions.

**Program Specific Outcomes (PSO’s):**

**PSO1:** A firm foundation in core physics, math, and current physics research topics;

**PSO2:** Ability to design and conduct original experiments, model physical phenomena, and analyze and interpret data;

**PSO3:** Ability to work collaboratively with a diverse team; understanding of the student’s professional and scientific ethical responsibilities

**(U/S 2(f) and 12B of the UGC Act1956, NAAC Accredited)**

** DESH BHAGAT UNIVERSITY, MANDI GOBINDGARH**

**Faculty of Engineering and Applied Sciences**

**Department of Applied Sciences**

**Program: PhD/M.Phil (Mathematics)**

**Course Work**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Title of the Course** | **External** | **Internal** | **Total** | **L** | **T** | **P** | **C** |
| 1 | MPhD-101 | Research Methodology | 60 | 60 | 120 | 4 | 0 | 0 | 4 |
| 2 | MPhD-152 | Mathematics | 60 | 60 | 120 | 4 | 0 | 0 | 4 |
| 3 | RPE-102 | Research Publications and Ethics | 40 | 40 | 80 | 1 | 0 | 2 | 2 |
| **Total** | | | 160 | 160 | 320 | 9 | 0 | 2 | 10 |

**L- Lecture, T- Tutorial, P- Practical, C- Credits**

**Course Code: MPhD-101**

**Title of the Course: Research Methodology**

|  |  |  |  |
| --- | --- | --- | --- |
| **L** | **T** | **P** | **Credits** |
| 4 | 0 | 0 | 4 |

**Course Outcomes:**

**CO1:** Able to select and define appropriate research problem and Parameters.

**CO2:** Able to select the data from different methods.

**CO3:** Able to organize and conduct research in a more appropriate manner.

**CO4:** Able to understand and apply statistical.

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| CO/PO Mapping  (S/M/W indicates strength of correlation ) S – Strong, M – Medium, W – Weak | | | | | | | | | | | | |
| COs | Programme Outcomes (POs) | | | | | | | | | | | |
| PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | M | M | S | M | M | M | W | W | M | S | M |
| CO2 | S | S | S | S | M | M | M | W | W | M | S | M |
| CO3 | S | S | M | S | M | M | M | W | W | M | S | M |
| CO4 | S | S | M | S | S | M | M | W | W | M | S | M |

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| **Unit** | **Course Outline** | **Hour(s)** |
| **I** | Research: Definition, Meaning, Purpose, Types of Research, Research Approaches: Quantitative & Qualitative, Significance of Research, Parameters and Variables in Research, Identification, Selection and Formulation of Research Problem, Research Design: Meaning & Types. | **12** |
| **II** | Sampling Theory: Types of Sampling, Steps in Sampling, Sampling & Non- Sampling errors, Determination of Sample Size. Data for Research, Primary and Secondary Data: Methods of data collection- Primary and Secondary Data. Data Processing, Editing, Coding, Quantitative and Qualitative Data, Analysis Techniques. | **13** |
| **III** | Literature Review: Its need and significance in Research, Sources of Literature Review, APA & MLA styles of Thesis writing, Meaning of Bibliography/References, Plagiarism. Synopsis: Steps involved in writing synopsis, Norms and standards in writing Research Papers, Report writing, Pagination, Footnotes. | **11** |
| **IV** | Statistical Inferences: Estimation & Hypothesis Testing, Type I & Type II Error, Parametric and Non Parametric Tests (Chi square test, z test,F test, Student t-test, Mann Whitney test, ANOVA (one way, two way), Computer Applications: MS Excel & SPSS for data analysis. | **9** |

**Total- 45**

**Recommended Books:**

1. Kothari, CR, Research Methodology- Methods and Techniques, New Age International Publishers, New Delhi.
2. Dash, Priyranjan, Research Methodology with SPSS, Varinda Publications (P) Ltd.
3. Gupta, S.P Gupta, M.P. Business Statistics, Sultan Chnad& Sons
4. Chandan, J.S. Singh. J, Khanna, K.K. Business Statistics, Vikas Publishing House Pvt. Ltd.
5. Hooda, R.P. Statistics for Business and Economics, Macmillan India limited, New Delhi.

**Course Code: MPhD-152**

**Title of the Course: Mathematics**

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| --- | --- | --- | --- |
| **L** | **T** | **P** | **Credits** |
| 4 | 0 | 0 | 4 |

**Course Outcomes:**

**CO1:** Understanding of the fundamental axioms in mathematics and capability of developing ideas based on them.

**CO2:** Inculcate mathematical reasoning.

**CO3:** Prepare and motivate students for research studies in mathematics and related fields.

**CO4:** Provide knowledge of a wide range of mathematical techniques and application of mathematical methods/tools in other scientific and engineering domains.

**CO5:** Provide advanced knowledge on topics in pure mathematics, empowering the students to pursue higher degrees at reputed academic institutions.

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| CO/PO Mapping  (S-Strong Correlation, M- Medium Correlation, W-Weak Correlation) | | | | | | | | | | | | |
| CO’s | Programme Outcomes (PO’s) | | | | | | | | | | | |
| PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | W | S | M | S | M | W | W | W | W | M | M |
| CO2 | M | S | M | M | W | M | M | W | M | M | W | S |
| CO3 | M | M | S | S | W | M | M | W | M | W | W | S |
| CO4 | M | M | S | S | W | M | M | W | M | W | W | S |
| CO5 | M | M | S | S | W | M | M | W | M | W | W | S |

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| **Unit** | **Course Outline** | **Hour(s)** |
| **I** | **Divisibility Theory in the Integers**: The Division Algorithm, The Greatest Common Divisor, LCM, The Euclidean Algorithm, The Diophatine Equation ax+by=c, The Fundamental Theorem of Arithmetic.  **The Theory of Congruences**: Basic Properties of Congruence, Binary and Decimal Representation of Integers, Linear Congruence, The Chinese Remainder Theorem | **12** |
| **II** | **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.  Assignment model: Formulation, Hungarian method for optimal solution, Solving unbalanced problem, Traveling salesman problem and assignment problem. | **13** |
| **III** | **Linear and Nonlinear Systems:** Eigenvalues and Eigenvectors, Elementary Row Operations, Gaussian Elimination, Echelon Form and Rank, Rank and Solutions, LU Decomposition, Matrix inversion using Iterative method, Jacobi method, Gauss-Seidel Method, Gauss-elimination method. | **11** |
| **IV** | **Probability Distributions:**The postulates of probability,Some elementary theorems, Addition and multiplication rules, Baye’s rule and future Baye’s theorem,Random variables and probability functions. | **9** |

**Total- 45**

**Recommended Books:**

1. K. Hoffman and R. Kunze, Linear Algebra, Pearson Education(India), 2003.

2. M. Artin: Algebra, Prentice Hall of India, 2005

**Course Code: RPE-102**

**Title of the Course: Research Publications and Ethics**

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| --- | --- | --- | --- |
| **L** | **T** | **P** | **Credits** |
| 1 | 0 | 2 | 2 |

**Course Outcomes:**

**CO1:** Understand the philosophy of science and ethics, research integrity and publication ethics.

**CO2:** Identify research misconduct and predatory publications.

**CO3:** Understand indexing and citation databases, open access publications, research metrics (citations, h- index, impact Factor, etc.).

**CO4:** Understand the usage of plagiarism tools.

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| CO/PO Mapping  (S-Strong Correlation, M- Medium Correlation, W-Weak Correlation) | | | | | | | | | | | | |
| CO’s | Programme Outcomes (PO’s) | | | | | | | | | | | |
| PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | S | M | M | M | M | W | S | M | S | M | S |
| CO2 | S | S | M | M | M | M | W | S | M | S | M | S |
| CO3 | S | S | M | M | S | M | M | S | S | S | S | S |
| CO4 | S | W | M | M | M | M | M | S | M | S | M | S |

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| **Unit** | **Course Outline** | **Hour(s)** |
| **I** | Philosophy And Ethics: Introduction to philosophy: definition, nature and scope, concept, branches – Ethics: definition, moral philosophy, nature of moral judgements and reactions.  Scientific Conduct: Ethics with respect to science and research – Intellectual honesty and research integrity – Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP) – Redundant Publications: duplicate and overlapping publications, salami slicing – Selective reporting and misrepresentation of data. | **15** |
| **II** | Publication Ethics:  Publication ethics: definition, introduction and importance  Best practices / standards setting initiatives and guidelines: COPE, WAME, etc  Conflicts of interest - Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types - Violation of publication ethics, authorship and contributor ship - Identification of publication misconduct, complaints and appeals – Predatory publisher and journals.  Open Access Publishing : Open access publications and initiatives - SHERPA/RoMEO online resource to check publisher copyright & self- archiving policies - Software tool to identify predatory publications developed by SPPU - Journal finger / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer, Journal Suggester, etc. | **15** |
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**Total- 45**

**Recommended Books:**

1. Nicholas H. Steneck. Introduction to the Responsible Conduct of Research. Office of Research Integrity 2007.
2. The Student's Guide to Research Ethics By Paul Oliver Open University Press, 2003
3. Responsible Conduct of Research By Adil E. Shamoo; David B. Resnik Oxford University Press, 2003
4. Ethics in Science Education, Research and Governance Edited by Kambadur Muralidhar, Amit Ghosh Ashok Kumar Singhvi. Indian National Science Academy, 2019. ISBN : 978-81- 939482-1-7.