ANNAMALAI UNIVERSITY

(Accredited with 'A+' Grade by NAAC)

CENTRE FOR DISTANCE AND ONLINE EDUCATION

Annamalainagar – 608 002.

Semester Pattern: 2023-24

[January Session]

Instructions to submit **First Semester** Assignments

1. Following the introduction of semester pattern, it becomes **mandatory for candidates to submit assignment for each course.**
2. Assignment topics for each course will be displayed in the A.U, CDOE website (**www.audde.in**).
3. Each assignment contains 5 questions and the candidate should answer all the 5 questions. Candidates should submit assignments for each course separately. (5 Questions x 5 Marks =25 marks).
4. Answer for each assignment question should not exceed 4 pages. Use only A4 sheets and write on one side only. **Write your Enrollment number on the top right corner** of all the pages.
5. Add a template / content page and provide details regarding your Name, Enrollment number, Programme name, Code and Assignment topic. Assignments without template / content page will not be accepted.
6. Assignments should be handwritten only. Typed or printed or photocopied assignments will not be accepted.
7. **Send all First semester assignments in one envelope**. Send your assignments by Registered Post to The Director, Center for Distance and Online Education, Annamalai University, Annamalai Nagar – 608002.
8. Write in bold letters, "**ASSIGNMENTS – FIRST SEMESTER**" along with PROGRAMME NAME on the top of the envelope.
9. Assignments received after the **last date with late fee** will not be evaluated.

Date to Remember

Last date to submit **First semester** assignments : **15.04.2024**

Last date with late fee of Rs.300 (three hundred only) : **30.04.2024**

Dr. T. SRINIVASAN

Director

(S018) - M.Sc MATHEMATICS

AY-2023-24 – FIRST YEAR - I – SEMESTER

(JANUARY SESSION) - Assignment Questions

018E1110 - ABSTRACT ALGEBRA

1. a) Prove that any group of prime order is cyclic and can be generated by any element of the group except the identity.

   b) If H and K are finite subgroups of a group G of order $O(H)$ and $O(K)$ respectively then prove that $O(HK) = \frac{O(H)O(K)}{O(H\cap K)}$.

2. a) State and Prove cauchy's theorem for abelian groups.

   b) State and Prove sylow's theorem for abelian groups.

   c) Let $\varphi: G \to \bar{G}$ be a homomorphism with $\ker K$ and $\bar{N}$ be a normal subgroup of $\bar{G}$, where $N = \{x \in G : \varphi(x) \in \bar{N}\}$then prove that $\frac{G}{N} \approx \frac{\bar{G}}{\bar{N}}$.

3. a) Prove that every integral domain can be imbedded in a field.

   b) Prove that the ideal $A = (p(x))$ in $F[x]$ is a minimal ideal if and only if $p(x)$ is irreducibleover F.

   c) Let V is finite-dimensional and W is a subspace of V then prove that W is finite dimensional,$\dim W \leq \dim V$ and$\dim V/W = \dim V - \dim W$

4. a) Prove that $\mathrm{I(G)} \approx {}^{G}/_{Z}$, where $\mathrm{I(G)}$ is the group of inner automorphisms of G and Z is the centre of G .

   b) Prove that an ideal M of an Euclidean ring R is a maximal ideal if and only if the ideal M is the principal ideal generated by a prime element of R .

5. a) If F is any field, prove that the ring $\mathrm{F(x)}$of all polynomials in x over F is a Euclidean ring.

   b) If V and W are of dimensions m and n respectively over F then prove that $\mathrm{Hom\,(V, W)}$ is of dimension mn over F.

018E1120 - REAL ANALYSIS

1. a) State and Prove Intermediate value theorem for Derivatives.

   b) State and Prove Chain rule for Derivatives.

2. a) Let f be of bounded variation on $[a,b]$and V be defined on $[a,b]$ as follows $V(x) = V_f(a,x)$ if $a \leq x \leq b$ and $V(a) = 0$ then Prove that
      i. $V$is an increasing function on $[a,b]$.
      ii. $(V - f)$is an increasing function on $[a,b]$.

   b) Write the Additive property of Total variation.

3. a) If $f \in R(\alpha)$on $[a,b]$, then prove that $\alpha \in R(f)$ on $[a,b]$ and $\int_a^b f\, d\alpha + \int_a^b \alpha\ df = \alpha(b) f(b) - \alpha(a) f(a)$.
   b) State and Proveeuler's summation formula.

4. a) State and Prove First Mean Value theorem for Riemann – Stieltges Integral.
   b) Write the necessary conditions for existence of Riemann- Stieltges Integrals.

5. a) State and Prove Tauber's theorem.
   b) State and Prove Abel's limit theorem.

018E1130 - DIFFERENTIAL EQUATIONS AND APPLICATIONS

1. a) Solve $y'' + 2y' + 2y = \frac{e^{-x}}{cos^3 x}$ by using the method of variation of parameter.
   b) Solve $y'' + 4y = 4\tan 2x$by using the method of variation of parameter.

2. a) Solve the Bessel equation $x^2y'' + xy' + (x^2 - n^2)y = 0$ in series taking $2n$ as non- integral.

   b) Solve the series the Legendre's equation $(1 - x^2)y'' - 2xy' + 4y = 0$ near the singular point $x = 1$.

3. a) Find the general solution of $(x^2 - 1)y'' + (5x + y)y' + (n + 1)ny = 0$.

   b) Drive the Gauss's hyper geometric equation.

4. a) Prove that

$$\int_{-1}^{1} P_m(x)P_n(x)dx = \begin{cases} 0 & if \quad m \neq n \\ \dfrac{2}{2n+1} & if \quad m = n \end{cases}$$

b) Find the first three terms of the Legendre series $f(x) = e^x$.

5. a) Prove that

$$\int_{0}^{1} x\, J_p(\lambda_m x)\, J_p(\lambda_n x)dx = \begin{cases} 0 & if \quad m \neq n \\ \dfrac{1}{2} J_{p+1}(\lambda_n)^2 & if \quad m = n \end{cases}$$

b) Prove that

$$J_p - J'_{-p} - J'_p J_{-p} = \frac{-2\sin p\pi}{\pi x}$$

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018E1140 - ANALYTICAL MECHANICS

1. a) Explain the kinetic energy of a rigid body with a fixed point and angular momentum of a rigid body.
   b) Explain general motion of the spherical pendulum.
2. a) Explain the equation of motion of a particle relative to the Earth surface.
   b) Explain general motion of a top.
3. a) Explain the Lagrange's equation for any simple dynamical system.
   b) State and prove Hamilton's principle.
4. a) Explain the Angular Momentum and General Motion of a Rigid body.
   b) Discuss the motion of a simple pendulum in terms of elliptic functions and the Periodic Time of the simple pendulum
5. a) Explain the motion of a Rolling disk.
   b) Describe the Lagrange's equations for motion of a particle in a plane.