

B. Tech. I Semester  
ODD SEMESTER  
MAJOR EXAMINATION 2018 - 2019

Subject Name: : Engineering Mathematics-I

Time: 3 Hrs.

Max. Marks: 50

Note: Attempt all questions. Each question carry equal marks.

1. Attempt any five parts of the following:

(5 × 2 = 10)

- (a) If  $u = \sin nx + \cos nx$ , then show that  $u_r = n^r [1 + (-1)^r \sin 2nx]^{1/2}$ , where  $u_r$  is the  $r^{th}$  differential coefficient of  $u$  w.r.t.  $x$ .
- (b) If  $u = \sin^{-1} \left[ \frac{x^{1/4} + y^{1/4}}{x^{1/6} + y^{1/6}} \right]$ , then find  $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2}$ .
- (c) Expand  $\sin(m \sin^{-1} x)$  in ascending power of  $x$ .
- (d) Using  $x = r \cos \theta$ ,  $y = r \sin \theta$ , transform the equation  $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$  into polar form as
- $$\frac{\partial^2 u}{\partial r^2} + \frac{1}{r} \frac{\partial u}{\partial r} + \frac{1}{r^2} \frac{\partial^2 u}{\partial \theta^2} = 0.$$
- (e) Show that the equations  $3x + 4y + 5z = a$ ,  $4x + 5y + 6z = b$ ,  $5x + 6y + 7z = c$  do not have solution unless  $a + b = 2c$ .
- (f) Find the rank of the matrix

$$\begin{bmatrix} 2 & 3 & -2 & 4 \\ 3 & -2 & 1 & 2 \\ 3 & 2 & 3 & 4 \\ -2 & 4 & 0 & 5 \end{bmatrix}$$

(g) Find the Eigen values and Eigen vectors of the matrix

$$\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$$

2. Attempt any two parts of the following:

(2 × 5 = 10)

(a) (i) Evaluate

$$\int_0^\infty \int_0^x x e^{-\frac{x^2}{y}} dx dy$$

(ii) Solve by using change of order of integration

$$\int_0^a \int_{\frac{b}{b+x}}^{\frac{b}{b-x}} x dy dx$$

(b) (i) Find the volume bounded by the surfaces  $x^2 + y^2 = 1 + z$  and  $z = 0$ .

(ii) Evaluate

$$\int_0^1 \frac{x^2 dx}{(1-x^4)^{1/2}} \times \int_0^1 \frac{dx}{(1+x^4)^{1/2}}$$

- (c) By means of substitution  $x + y + z = u$ ,  $y + z = uv$ ,  $z = uvw$ , evaluate the value of  $\iiint x^{-1/2} y^{-1/2} z^{-1/2} (1-x-y-z)^{1/2} dx dy dz$  taken over the volume bounded by  $x = 0$ ,  $y = 0$ ,  $z = 0$  and  $x + y + z = 1$ .

3. Attempt any two parts of the following:

(2 × 5 = 10)

(a) Show that  $\beta(m, n) = \int_0^\infty \frac{x^{m-1}}{(1+x)^{m+n}} dx = \int_0^\infty \frac{x^{n-1}}{(1+x)^{m+n}} dx = \frac{\Gamma m \Gamma n}{\Gamma(m+n)}$ .

(b) (i) Show that

$$\Gamma\left(\frac{1}{n}\right) \Gamma\left(\frac{2}{n}\right) \Gamma\left(\frac{3}{n}\right) \dots \Gamma\left(\frac{n-1}{n}\right) = \frac{(2\pi)^{\frac{n-1}{2}}}{n^{1/2}}$$

(ii) Evaluate  $\int_0^\infty e^{-ax} x^{n-1} \cos bx dx$  in terms of Gamma function. Use it to evaluate

$$\int_{-\infty}^\infty \cos x^2 dx$$

- (c) Evaluate  $\iiint \sqrt{a^2 b^2 c^2 - b^2 c^2 x^2 - c^2 a^2 y^2 - a^2 b^2 z^2} dx dy dz$  taken throughout the ellipsoid  $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ .

4. Attempt any two parts of the following:

(2 × 5 = 10)

- (a) (i) A fluid motion is given by  $\vec{v} = (y \sin z - \sin x)\hat{i} + (x \sin z + 2yz)\hat{j} + (xy \cos z + y^2)\hat{k}$ . Is motion irrotational? If so, find the velocity potential.

(ii) Show that  $\text{div} \left\{ \text{grad} \left( \frac{x}{r^3} \right) \right\} = 0$ , where  $r$  is the magnitude of position vector  $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ .

- (b) Evaluate  $\iint_S \vec{F} \cdot \hat{n} dS$ ,  $\vec{F} = 18z\hat{i} - 12\hat{j} + 3y\hat{k}$  and  $S$  is the surface of the plane  $2x + 3y + 6z = 12$  in the first octant.

- (c) Verify divergence theorem for  $\vec{F} = 4x\hat{i} - 2y^2\hat{j} + z^2\hat{k}$  taken over the region bounded by cylinder  $x^2 + y^2 = a^2$ ,  $z = 0$ ,  $z = b$ .

5. Attempt any two parts of the following:

(2 × 5 = 10)

- (a) (i) Find the greatest value of the directional derivative of  $\phi(x, y, z) = 2x^2 - y - z^4$  at  $(2, -1, 1)$ .

(ii) Find the directional derivative of  $xyz^2 + xz$  at  $(1, 1, 1)$  in the direction of the normal to the surface  $3xy^2 + y + z$  at  $(0, 1, 1)$ .

- (b) Verify Green's theorem in a plane for  $\int_C (3x^2 - 8y^2) dx + (4y - 6xy) dy$  where  $C$  encloses the region bounded by  $y = \sqrt{x}$  and  $x = \sqrt{y}$ .

- (c) (i) Apply Stokes' theorem to evaluate  $\int_C y dx + z dy + x dz$ , where  $C$  is the curve of intersection of  $x^2 + y^2 + z^2 = a^2$  and  $x + z = a$ .

(ii) Prove that  $\int_C \vec{r} \cdot d\vec{r} = 0$ , where  $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ .



B. Tech.  
SEMESTER -Ist  
MAJOR EXAMINATION 2018 - 2019  
Subject Name: Engineering Physics-I

Time: 3 Hrs.

Max. Marks: 50

Note: Attempt all questions. Each question carry equal marks.

1. Attempt any five parts of the following: (5 × 2 = 10)
- (a) What do you mean by frame of reference? What are the differences between inertial and non-inertial frame of reference?
  - (b) Derive the relativistic velocity addition theorem. Show that no material particle can travel faster than the velocity of light.
  - (c) The mass of a moving electron is 11 times its rest mass. Find the kinetic energy and momentum.
  - (d) Establish Einstein's mass-energy relation. Give two physical examples of Einstein's mass-energy equivalence.
  - (e) Compare the wavelength of a photon and electron having (i) Same momentum (ii) Same energy.
  - (f) What was the objective of Davisson-Germer experiment? Discuss the results of this experiment.
  - (g) State Heisenberg uncertainty principle. If the uncertainty in the location of a particle is equal to its de Broglie wavelength, then find out the uncertainty in its velocity.
2. Attempt any two parts of the following: (2 × 5 = 10)
- (a) Why the Newton's Rings are circular? Derive expression for the diameter of bright ring.
  - (b) A diffraction grating used at normal incidence gives a line  $\lambda_1 = 6000 \text{ \AA}$  in a certain order superimposed on another line  $\lambda_2 = 4500 \text{ \AA}$  of the next higher order. If the angle of diffraction is  $30^\circ$ , calculate the number of lines in 1 cm of the grating.
  - (c) Write the condition of secondary maxima for a single slit and show that the intensities of the successive maxima are in the ratio  
1: 1/22: 1/61: 1/121:.....
3. Attempt any two parts of the following: (2 × 5 = 10)
- (a) In Newton's ring experiment, the diameter of 4th and 12th dark rings is 0.4 and 0.7 cm, respectively. Find the diameter of 20th dark ring.
  - (b) The indices of refraction of quartz for right handed and left handed circularly polarized light of wavelength  $7620 \text{ \AA}$  are 1.53914 and 1.53920 respectively. Calculate the rotation of the plane of polarization of the light in degrees produced by a plate 0.5 mm thick
  - (c) Discuss the production and detection of plane, elliptically, and circularly polarised light?
4. Attempt any two parts of the following: (2 × 5 = 10)
- (a) Mention the essential conditions for lasing action. With the help of suitable diagram, explain the principle, construction and working of Ruby laser.
  - (b) What is holography? Explain recording and reconstruction of a hologram. List some important applications of holography.
  - (c) An optical fibre has NA of 0.20 and a cladding refractive index of 1.59. Determine the acceptance angle for the fibre in water, which has refractive index of 1.33.

5.

Attempt any two parts of the following:

(2 × 5 = 10)

- (a) Describe the construction and working of He-Ne Laser. How it is superior to a Ruby laser.
- (b) Describe the Propagation Mechanism of optical signals through optical fiber with suitable ray diagram.
- (c) Explain the following terms:
  - (i) Numerical aperture
  - (ii) Acceptance angle
  - (iii) Acceptance cone



**B. Tech.**  
**(SEM I) ODD SEMESTER**  
**MAJOR EXAMINATION 2018-2019**

**Industrial Psychology**

**Time: 3 Hrs.**

**Max. Marks: 50**

**Note: Attempt all questions. Each question carry equal marks.**

**1. Attempt any five parts of the following:**

**(5 x 2 = 10)**

- (a) Explain the objectives of time study, how it is conducted and its advantages & disadvantages.
- (b) "Hawthorne experiments were a turning point in the evolution of management thought." Do you agree with this statement? Why?
- (c) Provide a definition of motivation and explain the major elements of this definition. Also, explain the major ways in which studies/ researches on motivation have been summarized.
- (d) What is organizational culture? What are the primary characteristics that capture the essence of organization culture?
- (e) Explain, at least, three processes by which groups affect individual behavior.
- (f) What are the various individual and organizational strategies to manage stress?
- (g) What are the fundamental principles of Scientific Management theory? Describe how Taylor reorganized labor force at Bethlehem Steel using these principles.

**2. Attempt any two parts of the following:**

**(2 x 5 = 10)**

- (a) What are the various ways to classify psychological tests into various categories?
- (b) Explain how Engineering Psychology evolved as a distinct discipline over the years.
- (c) What are the major work-related factors that cause industrial accidents?

**3. Attempt any two parts of the following:**

**(2 x 5 = 10)**

- (a) What are the various physical factors that influence work environment in an industry?
- (b) Define Job Analysis. How it is helpful to the organizations in their HR activities?
- (c) "There is a broad range of industrial factors that contribute to the incidence and prevalence of fatigue." Please comment on this statement.

**4. Attempt any two parts of the following:**

**(2 x 5 = 10)**

- (a) Explain, in detail, what is performance appraisal and its objectives. What is the latest development in this area?
- (b) Elaborate your understanding of the absolute methods of performance appraisal.
- (c) Suppose you are HR manager in an organization. What methods you would follow to train the existing as well as new employees?

**5. Attempt any two parts of the following:**

**(2 x 5 = 10)**

- (a) What measures you would take or steps you would follow to ensure effectiveness of the training programme designed by you?
- (b) Explain what is training and what is development? Do they differ? How?
- (c) What do you understand by comparative methods of performance appraisal? Explain a few comparative methods.

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